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TROPICAL AGRICULTURE is published monthly at the Imperial College of Tropical Agriculture, St. Augustine, Trinidad, West Indies. Advertisement and subscription rates can be obtained at the College from the Editor, or from the Secretary of the College, 14, Trinity Square, London, E.C. 3, England. The Editor will be glad to consider authoritative articles for publication. It is understood that opinions expressed or recommendations made in signed articles or in articles of which the source is named are those of the author and do not necessarily represent the policy or opinion of the College Authorities. Increasing numbers of inquiries are being received from various parts of the tropics which can be answered only by persons possessed of an intimate knowledge of local conditions. Enquirers should first satisfy themselves that their local Department of Agriculture is not able to supply them with the desired information before communicating with us. Correspondence which will be replied to is invited on all other matters pertaining to tropical agriculture, science and development.

BANANA RESEARCH.

THE trade in bananas is yearly assuming more importance and the various interests concerned in the trade are naturally becoming more and more involved in problems both in the field and during the transport of the fruit, and this has necessitated their calling in the aid of scientific investigation. Some of the larger organisations such as the United Fruit Co. have already realised the facts of the situation and now have scientific officers attached to their staff, with others, the necessity for these investigations is only now becoming evident. It will be profitable at this point to mention briefly the directions in which research seems to be indicated having regard to the circumstances that have recently arisen.

The Gros Michel, which is at present the standard trade variety grown in the Caribbean area, is subject to Panama Disease (*Fusarium cubense*) and fears have been expressed from time to time that the whole trade may be jeopardized by the spread of this malady. This has led to much research into the causative organism itself. It is a fungus that is commonly present in the soil of most of the old established banana areas and one of the causes of its spread is the use of diseased planting material. Control measures have been recommended and adopted in the more important areas with varying degrees of success. Recent investigations have indicated, however, that the failure of so many plantations cannot always be attributed to this disease but that soil factors also have had a great deal to do with the matter. Also the disease seems particularly to affect plantations established on unfertile soils and in unsuitable situations. Thin unfertile soils, those with an unsuitable sub-soil, and areas liable to water-logging are particularly affected and in many cases early abandonment of plantations has had to be resorted to for one or other of these causes. Well drained alluvial soils of good fertility seem to be demanded by the Gros Michel, which would seem to be a variety that is particular in its requirements in this direction. That a regular supply of soil moisture is a factor, seems to be indicated by the fact that irrigable areas such as Colombia do not suffer from Panama Disease.

In order to circumvert this disease, attention has naturally been directed to the possibility of immune varieties. Different types from all over the world have been collected and tested for

resistance, whilst at the Imperial College of Tropical Agriculture a systematic attempt is also being made to breed new varieties, using seeded wild forms as male parents. This involves detailed cytological study and is definitely in the nature of long range research which will eventually add greatly to our knowledge. In the meantime attention is also being paid to existing varieties from various parts of the world that have now been tested and proved to be resistant or immune to Panama Disease. Several of these varieties are now known of which a few such as the Governor, Lacatan, Bumulan, Congo and Giant Fig, show reasonable possibilities as good croppers. None of them have shown quite the same commercial attributes as the Gros Michel and it is evident that they will need different methods of handling and treatment during storage and ripening. Low temperature research with the object of ascertaining whether it will be possible to standardize suitable temperatures and other conditions for their transport to overseas markets are now in progress at several places. One of the factors that intrudes at this stage is the occurrence of various diseases during transport. One of the most important of these is the disease known variously as Stalk or Stem End Rot. The increasing prevalence of this disease has compelled the various fruit companies to seek scientific advice, and the Department of Scientific and Industrial Research in England, as well as the College in Trinidad, have been consulted in the matter and have commenced a series of investigations.

The banana crop also needs more experiments to be carried out in the field and a thorough investigation needs to be conducted with such of the varieties as are known to be resistant and might prove possible substitutes for the Gros Michel. The Cavendish species, for instance, has for some years past been the main commercial banana of the Canaries and of the Queensland and Australasian trade, and the recent development that has led to the institution of a trade in bananas of this type between Brazil and the United Kingdom, is another case in point. *Musa Cavendishii* needs to be thoroughly examined as there is a reason to believe that the species includes several different types, which not only show varying degrees of immunity to Panama Disease, but also yielding capacity in the field and capacity for standing cold storage and transport.

Enough has been said to indicate that the problems connected with this important commercial fruit are many and varied, and that if they are to be solved expeditiously, co-ordinated research will be needed in order to avoid duplication and overlapping on the part of the various institutions that have already been asked to assist. The suggestion that has recently been put forward by Sir William Hardy, the Director of the Low Temperature Research Station of Cambridge University, to the effect that a Conference should be convened by the Empire Marketing Board, at an early date, to co-ordinate banana research, has therefore come at a very opportune time. The chief commercial firms interested in the export of bananas to the United Kingdom should be asked to send representatives, and to place their problems before the representatives of the various scientific institutions that are likely to be in any way involved in these investigations. In addition to the Cambridge and Trinidad Low Temperature Stations, the Bureau of Mycology, the Royal Botanic Gardens at Kew and other institutions connected with the Food Investigation branch of the Bureau of Scientific and Industrial Research, would need to be represented and it would also be advantageous to invite the co-operation of Australian interests, as the experience gained in that part of the world would undoubtedly prove of value to the Conference.

WORLD PRODUCTION OF KAPOK.

ALTHOUGH kapok is produced in India and British Malaya, and is also capable of being grown on a commercial scale in other parts of the British Empire, a very large proportion of the world's commercial supply of this material comes from Java and Madura in the Netherlands East Indies. Kapok is chiefly used in stuffing mattresses and pillows, and for upholstery purposes, but it has quite a number of other uses, such as in lifebelts, toys, light blankets, surgical dressings, insulation of refrigerators, &c.

Details published in a recent issue of *Commerce Reports* (Washington, D.C.) show that 18,544 metric tons of kapok were exported from Java and Madura in 1928, as compared with only 3,454 metric tons in 1900. Since 1915 the United States has been the largest buyer; the Netherlands generally has been considered the second most important purchaser, but several times it has assumed first place; Australia has consistently retained the third position; and New Zealand is the fourth most important buyer of Javanese kapok. Most of the kapok trees in Java are found along the roadside or bordering paddy fields. Not more than six to eight per cent. of the kapok grown comes from estates.

Good quality kapok (when properly prepared) is exported from India, shipments in 1928 amounting to 36,356 cwt. In 1927, however, they totalled 50,344 cwt. It grows wild throughout the hotter provinces of India, but there is little attempt to cultivate it and only a fractional part of the crop is gathered. As might be expected in these circumstances, the fibre is on the whole not so free of foreign matter, such as seeds, leaves, sticks, &c., as it might be. British Malaya has a small kapok industry, which in 1928 exported 150 tons. The fibre is also grown in the Philippine Islands, Ecuador, China and other countries.—(*The Chamber of Commerce Journal*, Vol. LIX, No. 829.)

RICE.

Cultivation and Treatment.

By C. E. Douglas.

World Production.

Among tropical products, there is no crop so vast as rice: the geographical incidence of this cereal is probably more widespread than that of any other vegetable product, whether cereal or otherwise. There is no other food so universally employed: rice is the staple diet of nearly half the human race.

Rice yields vary from year to year and annual records of these yields are available in most of the agricultural journals of the world. The writer of these notes sees no reason, however, to modify appreciably the approximate figures collected a few years ago for his little handbook on "Rice,"—which figures are reproduced here by courtesy of Sir Isaac Pitman & Sons.

The yields of husked rice credited to the principal rice-growing countries, per annum, are as follows:—

	Tons.
British India..	35,000,000
The Japanese Empire.. ..	10,600,000
The Netherlands East Indies	4,250,000
French Indo-China	3,500,000
Siam	2,500,000

The United States of America, The Philippine Islands, Madagascar, Egypt and Italy, each produced from 350,000 to 600,000 tons per annum, varying according to seasonal conditions.

It should be noted, however, that while the average yield of the great Eastern rice countries may keep reasonably constant, the production of the smaller rice-producing countries may vary considerably from year to year merely because rice is not their principal crop, nor is its cultivation and treatment their principal industry: in these cases, the extent of its cultivation in any year is governed by other and more important considerations.

The figures for the main rice countries are, however, sufficiently impressive. When one reads of 12 million acres under rice in Burma, another 12 or 13 million in the Central Provinces of India, with perhaps 40 million acres in Bengal, Bihar and Orissa (and an area probably at least equal to the sum of all these in China), one begins to realise the vast extent to which this particular cereal is grown.

Again, comparing Oriental with Occidental production, the exportable surplus from Burma alone is equal to the total production of the United States of America, the Philippine Islands, Egypt, Spain, Italy, Brazil and Ceylon all lumped together.

So much for the general total yield. There is, however, a notable difference in the yield per cultivated acre. While the yield of British Indian rices averages out at rather over half a ton per acre, yields in Japan, Spain and Egypt, and also in British Guiana, average out three times as high.

The writer has personally met with not specially isolated cases where the yields have been as high as three to three and a half tons per acre, and that in areas not prepared, manured or irrigated in any special way with a view to high yields.

Varieties.

Turning now to varieties, we know that there are, literally, several thousands of these: but neither the merchant nor the housewife—who, in Europe and America at least is the ultimate criterion—is concerned with such distinctions, but only with three or four types.

In certain areas, special rices are grown which never appear in the world markets, except as curiosities: they are grown for local demands and, however valuable they may be within the limits of these localities, they have no place in the world's commerce.

Take, for instance, the fine small rices of Tonkin; the red Sabaini (so called 70 day) rice of the Fayoum, in Egypt: or the small Mattasamba rice of Ceylon: these are perfectly good as food and even, no doubt, highly prized by the people living in their area of production. Outside that area, however, such rices are unknown and create no demand.

Roughly speaking, the world's markets demand three standardised types which may be classified as Japanese, Patna, and American. Burma rice* stands almost by itself, and yet, as might be expected in a country having such vast areas under cultivation, there are some definitely different types among well over 1,000 varieties cultivated there.

It is not proposed to deal at length here with the production of any specific area, but rather to give a general review of the subject as the result of observations in different countries visited by the writer.

The three main types referred to above are quite definitely distinguishable.

1. *Japanese Type.* This is an almost round, barley type grain which has been successfully cultivated in many lands outside Japan, notably in Spain and Egypt.

   As paddy, *i.e.*, in the husk, this grain runs about 7 m/m long by 3½ m/m wide by 2¼ m/m thick: shelled, or after the husk is removed, the corresponding dimensions become, say 5 m/m by 3 m/m by 2 m/m.

* *Rice in Burma*, by Mr. David Hendry, M.C., B.Sc., Deputy Director of Agriculture, Southern Circle, Burma. *Tropical Agriculture*, Vol. V, Nos. 1, 2, 3

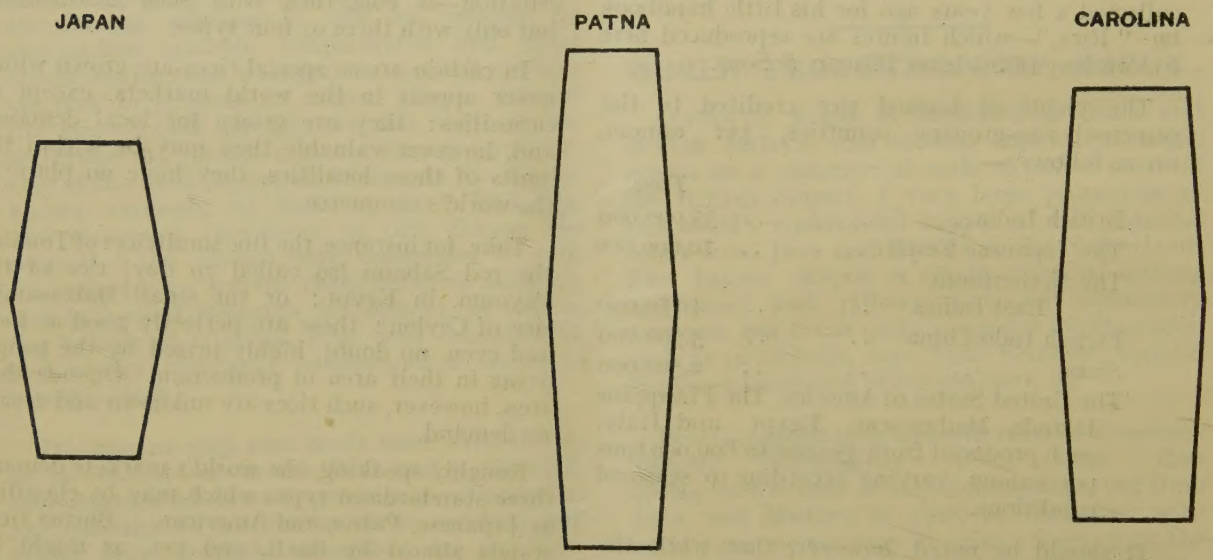
2. *Patna Type.* This is a relatively long, thin, cylindrical grain as far opposed as possible to the Japanese type. Siamese rice is similar in form. The average dimensions of the paddy run to $10\frac{1}{2}$ to 11 m/m by $2\frac{3}{4}$ m/m by 2 m/m, while the shelled rice runs about $7\frac{1}{2}$ m/m by 2 to $2\frac{1}{4}$ m/m wide by $1\frac{3}{4}$ m/m thick.

3. *American Type.* The well-known Carolina rice is chosen in this comparison because it is a recognised standard variety of distinction, commanding a high price in the world's market.

As paddy, this grain runs from 9 to 10 m/m long by 3 to $3\frac{1}{4}$ m/m wide by $2\frac{1}{2}$ m/m thick: the corresponding dimensions of the shelled rice are 7 m/m by $2\frac{1}{2}$ m/m by 2 m/m.

It is remarkable how closely individual grains of recognised standard varieties conform not only to type but as regards dimensions. An interesting comparison can be instituted by setting out diagrams indicating the length, width and thickness of the individual paddy grains. The length of the diagram is say six times the length of the grain, the width of the centre six times the breadth of the grain, the width at each end is six times the thickness of the grain. Even if several diagrams, based on the dimensions of a number of similar type grains, are made and superimposed on one another, such variation as may well occur in individual grains are found to be confined within narrow limits.

An illustration showing the comparison between the three standard types referred to is given herewith.



Diagrams of three characteristic Paddies.

The Height of the Diagram is 6 times the average length of the grain : the width of the diagrams at the centre thereof represents the width of the grains of paddy under consideration, while the width of the end of the diagrams represents the thickness of the paddy grains.

Generally speaking, genuine Carolina rice fetches the highest price, running to as much as £30 a ton, and over. Genuine Patna rice comes next, at round about £26 to £27 per ton: Spanish-Japanese type rice varies in price more than the other two, but has run from £16 to £19 during 1929. Burma rice, while of admirable quality and having a food value at least equal to that of the more expensive varieties, runs from about £12 to £15 per ton.

Rice Cultivation.

Apart from Western countries where wages are much higher than in the East, and where more money, and the latest agricultural machinery are alike available, there is little difference between the methods of cultivation adopted in one Oriental country compared with another.

Three conditions are essential for growing rice: plenty of water, an impervious subsoil to prevent that water from draining away, and an adequate temperature.

A medium loam is a suitable soil in which to grow rice, provided always that it can retain water. Water there must be, whether obtained from natural rainfall over a sufficiently extended period, as in India, Siam, French Indo-China, Japan and Java; or by irrigation only and not from rainfall, as, for example, in Egypt, and to a great extent in Italy.

The usual procedure is to plough the land thoroughly in the spring, or immediately the first rains have softened it sufficiently; it is then harrowed and levelled and probably ploughed again. A level rice field is essential: otherwise it is impossible to maintain an even depth of water over the soil. (Fig. 2.)

RICE CULTIVATION AND TREATMENT.

FIG. 1.—*A typical spray or panicle of Egyptian Rice.*

FIG. 2.—*Levelling rice fields in Egypt.*

RICE CULTIVATION AND TREATMENT.

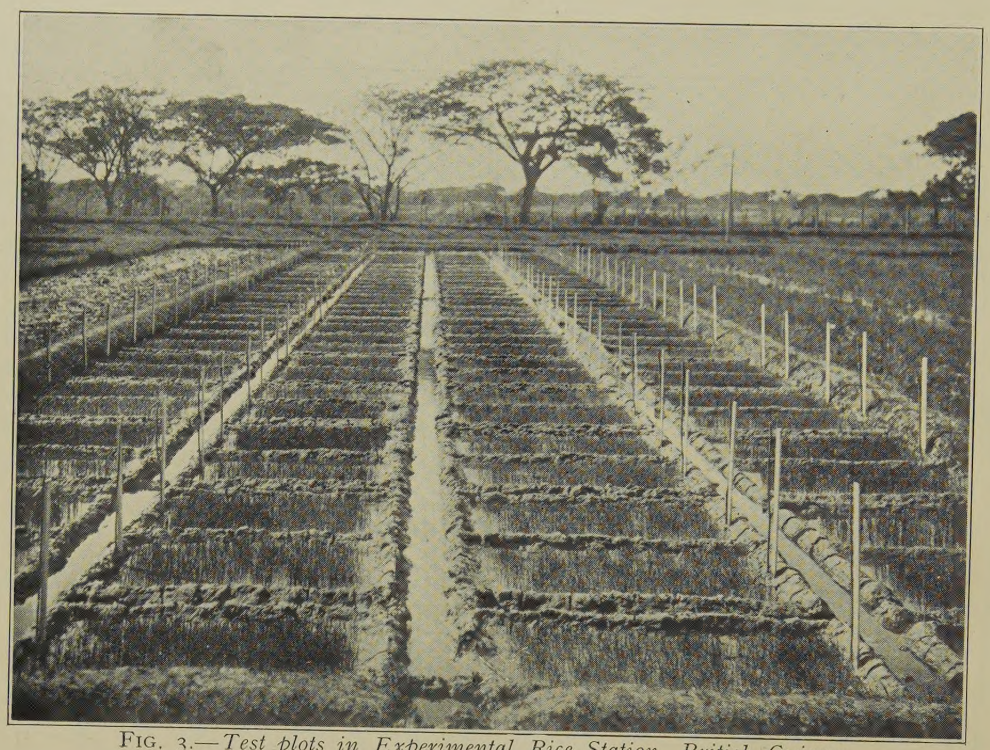


FIG. 3.—*Test plots in Experimental Rice Station, British Guiana.*

FIG. 4.—*Good field of rice, ready for harvest, Egypt.*

Almost universally throughout the East ploughing is done by a pair of oxen, the plough being of the simplest possible description. Deep ploughing is not necessary for rice. The use of light American ploughs operated by motor tractors is now becoming more common, although such machinery is far beyond the dreams of the great majority of Eastern cultivators.

While a pair of oxen will plough on the average three quarters of an acre per day, a light tractor plough can easily deal with six acres in the same time.

Tractors, if employed, must have amply broad wheels; in certain districts—depending on the nature of the soil—tractors with caterpillar wheels are almost essential.

At this point, a word about manure is appropriate. Heavy cropping occurs, year after year, in British Guiana, without using manure of any description. In Egypt, apart from experimental plot work, the only manurial effect is obtained by sowing berseem or clover, among the rice as it comes to maturity. After the rice is harvested, cattle are turned on to the field to graze, and ultimately, the berseem roots, together with the old rice stubble are ploughed in.

In some of the important rice areas in the United States of America, soya bean is planted as a green manure: all such leguminous crops are of great value to rice.

Farmyard manure is excellent, but difficult to collect and distribute in countries where millions of acres are under rice; for the same reason, as well as on the score of expense, the application of chemical manures is strictly limited. In any case, the application of artificial manures should only be done in consultation with a soil chemist.

In Japan—as in China—a dressing compounded of green and farmyard manures and village sewage, is almost universally employed, with highly satisfactory results.

Seed Selection.

While this obviously is of primary importance it constitutes a very difficult problem in the great rice growing countries of the East, where production is in millions, and seeds must, therefore, be reckoned in tens of thousands of tons. Japan, more than any other great rice country, has more or less solved the problem by most rigorous inspection in all the rice growing prefectures. In a highly developed agricultural country like the United States of America, seed selection becomes a relatively simple matter, the more so as the total quantity grown in the Southern States and in California combined, is only a fraction of the production of British India alone.

The smaller the area under cultivation, the more easily can the difficulty be got over. It is a trivial matter to grade and specially select one ton of seed to produce 50 or 100 tons of paddy: but how to set about the selection of the quantity of seed necessary to yield several million tons of paddy is a problem of infinitely greater magnitude. It can only be dealt with by the gradual introduction, in the most favourable areas, of seed selecting stations and seed farms, and the gradual extension of the system as and when circumstances permit.

Various mechanical methods of seed selection have been tried in different countries. Naturally, the principal object of seed selection is to get uniform grain—uniform not only as to its behaviour in the field, its time of maturity and its yield—but also as to its physical characteristics on milling, and its subsequent appearance on the market.

Paddies which grow with a long awn or beard at the end of the grain are a curse to the good miller, though the rice itself may be excellent. Rices which exhibit a red cuticle surrounding the kernel under the husk are also most annoying; they require an unnecessarily high degree of milling—often involving considerable breakage of the grain—before commercially attractive white rice can be produced.

Personally, the writer would say: "root up and burn all awned and red rice:" there are plenty of other varieties to select from.

Selection being more or less satisfactorily effected, the seed is frequently placed in bags which are well soaked in water and then covered over with mats to start germination; immediately after which it is sown, the surface of the soil having previously been well puddled.

In America, rice is sown by drills but in the East it is broadcast—at least as regards the nursery beds. As soon as the seed has taken root, water is admitted to the field and a depth of from five to six inches is maintained, if possible, during the whole period of growth. (Fig. 3.)

Rice is preferably sown in nursery beds, from which after four to six weeks, it is transplanted to the main fields, which of course must also be levelled, puddled and watered to receive the seedlings. These are planted in rows some eight or nine inches apart, two or three seedlings to each hole.

Harvesting.

The life period of different rice varies considerably: in some cases it is as short as 80 or 90 days, as for example in the case of Sabaini rice in Egypt: in other cases, it may require a period of 200 or 210 days, or even more, to attain maturity. From 140 to 150 days is a fair average; generally speaking, the longer the period of growth, the better the rice. Efforts have been made to find a reliable short-dated variety suitable for conditions and countries where rainfall is deficient or irrigation supplies are difficult: but up to the present it may be stated in general terms that even 120 days is little enough time in which to expect a sound crop.

When the grain is ripe, it is customary to run all water off the fields two or three weeks before harvesting, so as to allow the ground to dry out.

While in America reaping is done by machine, by far the bulk of the world's supply is harvested by hand, being cut with a longer or a shorter straw according to local requirements. The remaining straw is left on the land and is either trampled down by cattle or is allowed to rot and is ploughed in next season. In certain cases it is burnt.

After the grain is cut, it should be stacked or hung in the open for two or three weeks, if possible, in order to dry it out. It is dangerous to store damp grain. Thereafter, it is thrashed either by being trampled out by oxen (in which case the grain may be cut with a relatively short straw) or it is cut with a long straw, and thrashed by striking the grain over the edge of a tub, a sparred table, or even over a board set up on edge. Needless to say, all these methods are crude, slow and wasteful, but they are cheap, and they persist.

Properly designed mechanical thrashers are being increasingly employed to take the place of the older methods. These are usually most conveniently operated by crude oil, or paraffin engines. The machine may be stationary or portable, depending on local conditions: it may often be convenient to place the thrasher and engine in a barge, which can then be towed, by means of irrigation canals, to appropriate centres. Village districts may instal a machine to which the small cultivators can often conveniently enough convey their paddy in the straw. A well designed rice thrasher will also clean and dress the paddy.

Where mechanical thrashers are not employed, it is essential to clean the paddy which has been trodden out by oxen. It is impossible to prevent the grain thus thrashed becoming mixed with mud, bits of straw and animal excreta: moreover, there is usually a certain amount of dead or immature grain: all this waste matter would be taken out in mechanical thrashers: but if these are not available, the trodden-out grain should at least be passed through suitably designed grain cleaners, to remove useless material.

Milling.

We now come to the final treatment of the cleaned thrashed paddy. In India, in Ceylon, in British Guiana, and now to a considerable extent in Burma, the paddy is subjected to a preliminary process known as par-boiling. This process is carried out almost exclusively for the benefit of East Indian consumers, whether in their own or other countries.

The paddy is first steeped in warm water for a period varying from 20 to 30 hours, and, after draining, is then subjected for a period of 10 to 15 minutes, to the passage of low pressure steam. The sodden grain is then spread out on concrete floors and exposed for a day or two to the heat of the sun, which dries it uniformly. It is then ready for milling.

The advantages derived from this process are, that the grain is shelled with the greatest possible ease: that being greatly toughened by the process, it can be subjected to severe milling without too great loss from breakage: that it keeps better: and that it is undoubtedly more nourishing than the white rice of European and Western commerce.

It is freely eaten and appreciated by Europeans living in the areas where it is prepared, while yellow or pale coffee colour when milled, it turns practically white on cooking.

Rosetta, in Egypt, has a method of rice preparation entirely its own. There the paddy is pounded in large mechanically operated mortars with an admixture of rock salt and gypsum. The resultant rice finds a ready market in the Levant but the writer has never come across a similar method of treatment outside Rosetta.

As far as the pounding is concerned, this is a more or less modern development of the crude method of milling adopted by most native races throughout the world. The mortar may be a hollow scooped out of the hard earth, or it may be a hole cut in the stump of a tree; the pestle may be a bamboo shod with an iron band and raised and lowered by hand, or it may be a ram of hard wood attached to one end of a pivoted wooden beam, the other end of which is depressed and released by foot. The principle is the same; the process is slow, but the results are not too bad.

The primitive miller then scoops out the contents of his mortar and probably tosses them in the air to give the wind a chance of winnowing away the husk and light bits of broken grain; the balance is his rice of commerce.

Where the paddy has been previously toughened by par-boiling, or where its form and character is robust enough to stand the treatment, this machine does wonderfully good work. It requires, however, considerable power in relation to its output; it destroys the husk, and provides no means for the separation and recovery of the valuable bran (from the cuticle of the rice) or of the broken grain.

In small native mills treating four or five tons of paddy per day and producing par-boiled rice, or a second or third quality white rice, this machine has a definite place. Where it is a question of treating high grade white (unboiled) rice in considerable quantities, other methods are adopted.

It is perhaps difficult for the layman to appreciate that, in Burma, French Indo-China and Siam, there are probably hundreds of mills each treating several tons of paddy per day. One hundred tons of paddy will produce approximately 65 tons of rice; there are mills in Burma and in Indo-China capable of milling anywhere from 1,000 *to* 1,500 *tons of paddy per mill per day.*

In these modern mills, paddy cleaning machines, of one design or another, are always installed because the miller can never be sure that all, or indeed any of his incoming grain has been cleaned.

The clean paddy is then passed to the shellers, which consist of an upper fixed disc and a lower one rotating at high speed. Both discs are coated with a special mixture of emery and cement and the paddy is introduced through a central hole in the upper fixed disc. The distance between the emery faces and the discs can be adjusted—even while the machine is wo king—to suit the character of the grain.

The product of this machine is shelled grain mixed with a proportion of smaller still unshelled grain, and husk.

All this is passed through a winnowing or aspirating machine to remove the husk which is collected and used as fuel. All the mills in Burma, Siam and Indo China are driven by steam engines and the only fuel used is the husk obtained from the paddy.

The shelled and unshelled rice are then passed to a special separator which divides the shelled from the unshelled grain. The latter is returned to the shellers, while the shelled grain is passed on to be whitened.

The shelled grain at this point is often termed "Loonzain;" it is also shipped as "Cargo Rice," containing say from two per cent. to five per cent. of paddy and ten per cent. of broken rice. As the husk is 20 per cent. of the weight of the full paddy grains, this weight is saved in shipment and the husk is retained as fuel. The brown, or Cargo, rice (or "Loonzain") is then often shipped to Europe and to America and Canada to be milled up to the required degree of finished white rice.

Whitening consists of removing the cuticle (which lies beneath the husk and surrounds the kernel) by attrition between a rapidly revolving iron cone—again covered with a mixture of emery and cement—and a stationary wirecloth casing. The cuticle is rubbed off the kernel and passes through the meshes of the wirecloth as meal or bran. It is a most valuable cattle food as it contains from 16 per cent. to 18 per cent. of oil.

The now whitened rice may be and often is passed through yet another cone machine, coated, pe haps, with finer emery and surrounded, possibly, by a lighter wirecloth. Thus the whitening process is continued; by using several cones in series, each lightly milling only a small percentage off the surface of the grain, a high degree of finish can be attained with a minimum of broken rice.

It is incorrect to speak of this rice as polished; it is only pearled or whitened, and it is not necessary to carry the process further. Modern markets, however, demand something even more attractive; when this is the case, the whitened rice is passed through polishers, consisting of wooden drums covered with sheepskin (wool exposed), the rice being rubbed by the soft skins against still finer wirecloth.

The surface of the grain is now white and smooth, but still further refinements are often adopted. The rice may be lightly steamed and oiled to give it a transparent appearance, or it may be revolved in a drum along with a previously prepared mixture of talc and glucose, which together impart an artificial glaze to the grains. This is known as glazed or coated rice, which has no merit beyond an attractive appearance. Incidentally, all the polish and glaze disappear when the rice goes into the cooking pot.

There are, of course, intermediate stages and auxiliary machinery for separating out broken rice, which, in large mills, it often carried to an accurate degree of classification. Graded broken white rice usually commands a good market; it is used for conversion into high class laundry starch, into alcohol, for brewing, for making rice flour, and, when finely crushed, for making face powder and pharmaceutical preparations.

In short, there is very little of the original grain lost in a modern mill. Husk, broken rough rice, bran or meal, whole rice, and broken white rice are all recovered and bagged off for their particular use or market.

Accurate records are kept of input and outputs, and by this means it is possible to control, easily and intelligently, the most economical operation of a mill to suit varying market conditions.

This, briefly, is the condensed story of the cultivation and treatment of rice from start to finish.

"FISH POISONS" FOR INSECT SPRAYS.

THE Indians of British Guiana have for many years poisoned streams and creeks with the seeds and roots of certain native plants, in order to stupefy the fish and catch them for food. An attempt is now to be made to cultivate some of these plants for commercial use as insect sprays and animal dips, and the Empire Marketing Board has made a grant for an investigation.

White and Black Haiari, Yarro-conalli roots, Conami seeds, Conaparu and Dankamai, are the most important of these "fish poisons." Roots and stems of Haiari were recently sent for test to the Rothamsted Experimental Station, Harpenden. It was found that they contained the same poisons as the Derris root, which is grown commercially in the East. Rothamsted scientists described the Haiari poisons as "two of the most powerful insecticides that have so far come within our experience."

At present these and other poison plants are found wild in the forests. It is planned to grow them at an agricultural experimental station in British Guiana in order to test their suitability for commercial cultivation.

FIJI SUGAR.

The "Cane Farming" Industry.

By C. Y. SHEPHARD.

[*The writer is indebted to Mr. F. C. T. Lord, Attorney of the Colonial Sugar Refining Company, Ltd., in Fiji for most of the information embodied in the following article. Mr. Lord was unfortunately unable to see these notes in proof.*]

Introduction.

FIJI, like other sugar producers in the British Crown Colonies, suffered severely from the post war slump in sugar prices. Severe labour troubles resulted in an alarming drop in the production of sugar. At one period, the extinction of the industry appeared imminent. The Colonial Sugar Refining Company then embarked upon the bold experiment of dividing its estate lands into smallholdings of 10 to 12 acres for the cultivation of sugar-cane by East Indians. A description of this rapid development of the 'cane farming' industry, which has resulted in the re-establishment of the sugar industry, may be of interest to producers confronted with similar problems in other parts of the Empire.

General.

The Colony of Fiji consists of a group of about 250 islands, some 80 of which are inhabited. The islands are situated in the Southern Pacific Ocean between latitude 15 degrees and 22 degrees south, and between longitude 177 degrees west and 175 degrees east. The total area of the group is about 7,400 square miles. Viti Levu, the largest island, with an area of 4,100 square miles, is a little smaller than Jamaica, while Vanua Levu, the next island in importance, has an area of 2,400 square miles. The more important islands are mountainous, with peaks rising to more than 4,000 feet. The lower country, and much of the hill lands, are covered with forest trees, the low-lying lands especially having a deep soil, rich in humus, and easily worked. The islands are well watered, and possess fine rivers, some of which are navigable by boats and shallow draught steamers. Many of the islands are surrounded by barrier reefs through which numerous openings lead to safe anchorages.

Sugar is the principal industry, the amount and value exported being shown in the following table:—

SUGAR EXPORTS FROM FIJI.

Year.		*Quantity in tons.*	*Value in £.*
1924	..	44,472	768,110
1925	..	91,744	1,371,267
1926	..	56,991	808,195
1927	..	72,753	1,125,215
1928	..	120,683	1,827,095

Copra and bananas form important but subsidiary industries, the value of the amounts exported being shown, in relation to the total exports of the Colony, in the following table.

EXPORTS FROM FIJI.

Value in £.

Year.	*Copra.*	*Bananas.*	*Total Exports.*
1924	484,496	115,246	1,442,215
1925	497,713	132,491	2,107,014
1926	573,475	138,040	1,647,364
1927	534,416	157,819	1,930,208
1928	567,254	147,781	2,701,251

The manufacture of sugar is entirely in the hands of the Colonial Sugar Refining Company, Ltd., which operates five factories, four in Viti Levu, and one in Vanua Levu. The total capacity is approximately 100,000 tons of sugar per annum.

FIJI SUGAR FACTORIES.

Island.	*Factory.*	*Capacity in tons of sugar per annum.*
Viti Levu	Lautoka	43,000
Do.	Nausori	12,000
Do.	Rarawai	30,000
Do.	Penang	6,000
Vanua Levu	Labasa	15,000

Labour Difficulties and Remedial Measures.

The sugar industry dates from the early seventies of the nineteenth century, but the majority of the factories then established succumbed during the 1884 crisis. The industry was gradually re-organised and expanded, principally by the efforts of the Colonial Sugar Refining Company. From the commencement of its operations in 1880 this Company endeavoured to foster the production of cane by Europeans in order to supplement the supply of cane from its own plantations. Owing to the increased cost and inadequate supply of labour, coupled with the heavy fall in the price of sugar since the war, these planters were unable to produce cane at a profit, and the lands which they had leased reverted to the Company.

Labour was originally recruited from the neighbouring Pacific Islands, but the opportunity was soon afforded of employing some natives of India, who had been introduced by the Government for other purposes. Since they proved more suitable than the islanders, arrangements were made for the regular recruitment of labourers from India under an indenture system similar to that employed by British Guiana and Trinidad. These Indians soon constituted the main labour supply for the sugar plantations but, in 1917, the Government of India terminated the system of indenture, and, on 1st January, 1920, all existing indentures were cancelled. In the past, many Indians whose indentures had expired, showed a disinclination to work as wage labourers, and greatly preferred to cultivate land on their own

account. These factors resulted in a considerable shortage of labour on the plantations. The situation was rendered acute by the heavy fall in the price of sugar during the latter part of 1921, and, by 1923, the output of the Colonial Sugar Refining Company had been reduced to one-third of its normal quantity.

Remedies were sought in the introduction of labour saving devices and in stimulating cane growing by peasants.

Mechanical tillage was extensively practised and is still maintained on the small areas under estate control. The open drain system is being replaced by mole and tile draining, which results in a considerable saving of labour when once established. It was soon appreciated, however, that these measures, while relieving the situation to some extent, were quite inadequate as a sole remedy. It was decided, therefore, to embark upon the bold experiment of leasing the estate lands to tenant farmers.

At first, a share tenancy system was adopted, whereby the work of cultivating the land and reaping the cane was shared by the estate and the grower, the proceeds being equally divided. It soon became evident that the system would fail, as most share tenancy systems have failed, because the tenant confined his operations to such work as was likely to yield more than double the return sufficient to reward him for his labour. Consequently, the system was abandoned at an early stage in favour of a simple cash tenancy.

Most of the estate land is now divided into 10- or 12-acre blocks which are leased to tenant farmers for an original period of ten years, subject to renewal for a similar period. The rent varies between seven shillings and sixpence and one pound per acre, according to fertility and such permanent improvements as may have been effected before granting the lease. As a rule, the tenants live on the hill land in the vicinity of their holdings, but, where such house sites are not available, they live on the farm itself. This latter practice is considered undesirable on account of the damage to the cane caused by stock. The housing of labourers in barracks has been abandoned except for those working the land still in estate hands, and for those employed in the factory. In addition to the tenants of the Company, there is a large East Indian peasantry cultivating lands leased from the native owners through the medium of the Government. These two classes of cane growers produce 75 to 80 per cent. of the total cane supply and this percentage is being increased as suitable tenants are found. Eventually the Company will retain under estate cultivation an area sufficient only for training European personnel, conducting experiments, and providing an occupation for those who prefer to work as wage earners.

Most of the farmers are East Indians, but a few Fijians have recently become cane farmers, and are receiving every encouragement from the Company. This development possesses great potentialities. Apart from a comparatively small area of freehold, which was alienated prior to 1875, the land remains by statute in possession of the Fijians, who are prohibited from selling. Since the Fijians outnumber the Indians, and have not as yet engaged in cane cultivation to any appreciable extent, a considerable development would take place, if the Fijians could be enrolled as cane growers.

FIJI.—ESTIMATED POPULATION AT DECEMBER, 1928.

Race.	*Number.*
Europeans	4,591
Fijians	91,028
Indians	70,996
Others	10,178
Total	176,793

Cultural Methods.

Members of the European Staff of the Company, known as "Indian Officers," act as counsellors and organisers for both estate and independent tenants. Strict control is maintained by the officers over the estate tenants in order to conserve the fertility of the soil and to maintain the supply of cane. All land cultivated by, or leased from, the Company is worked on a 25 per cent. rotation, *i.e.*, one quarter of the area of any estate or farm is replanted annually so that one quarter each is under first year plant-canes, second year-plants, first-ratoons, and fallow, respectively. The average age of plant-canes at reaping is 16 to 18 months, and of ratoons, 12 months. Normally, only first-ratoons are reaped, but occasionally a second-ratoon is obtained from the best soils. This is considered, as the result of experience, to be the most intensive system possible consistent with present methods of cultivation. Although no direct control can be exercised over native leases, independent tenants have been induced to practise the same system.

The soils are sufficiently light to be worked by disc-ploughs drawn by animals, and the Indian Officers arrange for the peasants to combine their draught teams for this purpose. When land is to be fallowed, the trash is turned under, and a green manure crop planted with an application of coral sand. After the trash has rotted, the mature cover-crop is turned in. Before the final ploughing, potash and superphosphate are applied at rates of two and three hundredweights per acre respectively, and another green manure crop is planted. The cover-crop is usually Bengal or Mauritius Bean (*Stizolobium* sp.), though occasionally cow-pea (*Vigna sinensis*) or rice-bean (*Phaseol calcaratus*) is planted instead. The land then lies fallow until planted between January and May, to be reaped the following year between July and December. A nitrogenous manure is applied to ratoon-canes at the rate of two to three hundredweights per acre. Artificial manures are supplied

to all cane growers at practically landed cost. While all the available animal manure is utilised, its cost prevents it from being developed as an important source of manure.

Cane Delivery.

For transport purposes, the Company maintains 370 miles of permanent way for locomotive traction, and 160 miles of portable line for horse or bullock haulage, both of a standard gauge of 24 inches. The decision for the order of cutting cane rests with the cane inspectors, who take into consideration the age and appearance of the cane, and justify their choice, if necessary, by taking samples for analysis. Very little friction between factories and growers has arisen in this connection. Portable tram lines of the standard gauge are employed to transport the cane from the field to the permanent way. The portable line and trucks are delivered by the estate to the point on the main line nearest to the tenant's farm. The tenants are then grouped by the Indian Officer for the purpose of laying the tracks, reaping and loading canes, delivering them to the main line, and lifting and returning the track. The estates supervise and pay those assisting and charge the grower with the total cost, which is deducted from the payment for canes.

Payment.

The weight is taken over the weighbridge at the factory, the basic price being 10*s.* per ton of cane containing 13 per cent. "obtainable" cane sugar (sucrose content). This price is supplemented by an additional payment of 1*s.* 3*d.* per ton for every one per cent. sucrose content in excess of 13 per cent. Fractions of one per cent. are paid for *pro rata*. Similarly, a deduction of 1*s.* 8*d.* per ton is made for every one per cent. sucrose content below 13 per cent. Since 1923, the basic price of cane has been augmented by a payment of 3*s.* 6*d.* per ton, which is dependent for its continuance on the maintenance of the existing preferential tariff in Great Britain. The price does not vary, as in Trinidad, with the *f.o.b.* price of sugar.

Welfare.

The Company endeavours in a variety of ways to promote the welfare of its tenants. House sites and garden plots are provided at peppercorn rents, and, to assist in improving housing conditions, timber and galvanised iron are purchased at wholesale rates and sold at the lowest possible cost. Advances are also made for the purposes of cultivation. Interest at the rate of five per cent. is charged only on the amount outstanding at the termination of the crop season in December, but most growers succeed in liquidating their indebtedness before this date. Fortunately there is no malaria, while hookworm has been practically eliminated in the two districts where it formerly prevailed, by a campaign instituted by the Rockefeller Foundation and continued by the Government Medical Officers. Latrines of the "Bored-hole" type besides being inexpensive, have proved extremely successful, and are now being installed by the Company. Agricultural shows are held annually in each district, and the Company gives prizes and certificates for livestock, ploughing competitions, &c. The most coveted prize is that given for the best kept farm in each district, points being awarded throughout the year.

Conclusion.

The development of a peasant cane industry as a solution of the labour problem, and as a means of maintaining the production of sugar, is becoming increasingly important in cane sugar producing countries. The experience of Fiji, where it is claimed that a satisfactory remedy has been found, is therefore of considerable importance.

It was demonstrated in the course of this experiment that:

(i) The part-time grower is generally inefficient both as a cane producer and a labourer.

(ii) The holding should be of a size sufficient to provide full time occupation for the peasant and his family.

(iii) Cane growing cannot be successful if the tenants are relegated to inferior lands.

(iv) A share tenancy system results in an extensive and wasteful system of cultivation.

(v) Security of tenure is essential if the fertility of the soil is to be maintained.

(vi) In periods of depression, the cane supply cannot be maintained without a reasonable guaranteed minimum price.

(vii) With reasonable arrangements and sympathetic supervision, the grower can be persuaded to pursue a good system of cultivation whereby the land is regularly replanted, manured, and fallowed.

(viii) Tenants can be organised for the purpose of delivering a regular supply of mature cane.

(ix) Payment for cane can be made on the basis of sucrose content.

(x) With a well organised peasant cane industry, improvements can be effected in housing and sanitation.

While it is not suggested that similar results would invariably attend the introduction of such a system, it is recommended that the Fiji experiment is well worth studying in relation to peculiar local circumstances. To have restored the production of sugar from less than 36,000 tons in 1920 to more than 94,000 tons in 1928, is an accomplishment of no mean order, and one not without its lessons to other parts of the cane sugar producing world.

Literature.

1. Sugar in Fiji. *Tropical Agriculture*, Vol. V, No. 6, pp. 140 to 141.

2. The Colony of Fiji, 1874-1929. Government Printer, Suva, Fiji, 1929.

BANANAS.

The Behaviour and Diseases of the Banana in Storage and Transport.

(Précis of a Report submitted to the Empire Marketing Board.)

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(Our researches have been directed chiefly to the major problems of the industry, namely :—

(1) *The need for a substitute for the Gros Michel.*

(2) *The prevention of wastage in banana cargoes (both crated and uncrated), due to Main-Stalk Rot.*

The facts are, therefore, rendered in a form readily accessible to practical laymen.)

1. Introduction.

THE Low Temperature Station was erected for the study of the cold storage and transport of the banana; of late years the prevalence of Panama Disease, to which the Gros Michel banana, the chief variety of commerce, is susceptible, has necessitated a concerted attack on the problem from the genetical, pathological and physiological standpoints.

Our attack, then, involves plant breeding experiments with a view to the production of an immune or highly resistant hybrid of desirable bunch characteristics; secondly, the detailed study of the pathogenic organism, its mode of infection and spread, &c., with a view to curative or preventive measures; and thirdly, the selection of the most suitable of the existing varieties of proved immunity or high resistance, and the determination of the precise set of conditions suitable to its successful transport overseas and subsequent ripening to an attractive yellow colour. The following is an account of research work carried out by the Pathologist and the Physiologist in collaboration.

From the point of view of cold storage, the banana is perhaps unique among the fruits which have claimed the serious attention of the refrigeration biologist. Most fruits are confined to a short season annually. Such fruits are picked comparatively mature, and when they are held under suitable conditions, senescence and decline may be delayed for varying periods, according to the variety in question, thus serving economic ends. The banana, however, fruits all the year round, and thus the question of storing the fruit so as to avoid the low prices of the "glut" does not arise. Furthermore, in sharp contrast with other fruits, the banana is harvested quite green; after a short period, during transport at temperatures in the neighbourhood of 53° F., it is ripened up in a few days at a higher temperature (about 70° F.) and placed on the market. In dealing, therefore, with a proposed substitute for the Gros Michel variety, our problem is the determination of the correct stage of maturity at harvesting, and the precise conditions during transport and subsequent ripening, which will ensure that the product for market is a neat and orderly bunch of attractive colour.

2. Preliminary Storage Trials.

In selecting material for experimental storage, a careful and minute inspection of each individual fruit is necessary, so that fruit which is bruised or damaged in any way may be rejected. In the case of a "bunched" fruit of the habit of the banana, however, where successive whorls or hands fold back towards the central axis, this procedure is untenable. Further, no matter how carefully transport is arranged, a certain percentage of bunches are invariably bruised to a greater or less extent, quite apart from scratches, &c., from insects and animal life which make their abode there. In the earlier trials, therefore, instead of a wholesale rejection of bunches, all perceptible individual injuries—mutilations, bruises, broken stalks, damaged hands and fingers, &c.—were labelled, and further developments noted in the course of inspection at regular intervals. In addition, several deliberate punctures were made and certain fingers were twisted, these being labelled too. In due course the labelling was dispensed with, as it soon became evident that the behaviour of bruises, mutilations, &c., was standardised—there was a tendency to darken in colour during the storage at the cool temperature, which later, on transference to the ripening room at higher temperatures, developed into blackened patches, with the establishment of *Gloeosporium* and other fungi. In the case of fingers twisted and damaged at the stem, the progress of infection in the advanced stages was accompanied by finger-dropping.

While our attention was drawn to the alarming wastage in banana cargoes, due to main-stalk rot, the amount found in our chambers was practically negligible, due chiefly to the rapidity with which our small consignments were cooled down. It was realised, however, that in bulk storage the problem would become more acute. The effect of cutting the stems with a hot, sharp knife, making a clean cut, and smearing with ordinary laboratory vaseline, gave good results from the start. Later experimental work showed that it was not necessary to heat the knife. Various antiseptic solutions, melted fats, tallows, &c., were not tried, as it was felt that this simple smearing operation, which was quite efficacious, would be far more practicable in large scale operations.*

* While the vaseline treatment of stems has been a part of ordinary laboratory procedure from our earliest storage trials, priority in this matter goes to Dr. Tomkins of the Low Temperature Station, Cambridge, in whose name, we learn from London correspondence of 11th April, 1930, a patent has been granted. We wish to record our pleasure in confirming this treatment, though we draw attention to its applicability in large scale operations, and stress the futility of applying vaseline, even in generous quantities, to stems either badly cut or bruised below the cut.

In the earlier trials, the Gros Michel was used as a standard of comparison, and the behaviour was studied of a number of varieties—Lacatan, Cavendish, Bumulan, Congo, Giant Fig, Red Claret, and the hybrid GM x B2—when kept for varying periods of 14 to 17 days at fixed temperatures ranging between 53° F. to 60° F. with humidities between 65 and 90 per cent., after which they were ripened up at 70° F.

Full descriptions of these varieties appear elsewhere in print, so repetition will be avoided here. A summary of characteristics evident after cool storage for 14 days and subsequent ripening, will be found in Table I.

Table 1.

Observation on	Gros Michel.	Lacatan.	Cavendish.
Appearance of bunch.	Perfectly symmetrical; fingers upright and converging back to central axis.	Symmetrical when green; loses symmetry when ripening; fingers tend to spread towards the horizontal.	The usual objection on account of outward curvature of the fingers not fully justified (*see* bulk storage trials).
Colour when ripe.	Excellent deep yellow hue.	Occasionally excellent, but frequently a poor pasty colour; bruises show badly.	Excellent but pale and tendency to freckling with advancing maturity.
Flavour.	Standard.	Excellent, and high sucrose.	Better than Gros Michel, but not so sweet as Lacatan.
Texture.	Standard.	Delicate.	Delicate.
Evenness of ripening.	Highly uniform.	Vigorous bunches ripen evenly, but majority unevenly. *	Highly uniform.
Disposition of fingers.	Finger-stem sufficiently fibred to hold fingers erect until reaching over-ripe stage.	Often departs from erect position with maturity; finger stalks seem deficient in fibre.	Finger-stem sufficiently fibred.
Pre-disposition to mechanical injury and bruising.	Comparatively thick-skinned, allowing of fairly rough handling.	Very thin skin; all bruises show badly, even at early stages.	Very susceptible to injury.
Speed of ripening of "¾-full" bunch at 70° F. after 14 days' cool storage.	4-6 days.	Very uncertain; vigorous bunches 5-8 days, but usually 10-14 days. *	4-6 days.

Observation on	Bumulan.	Congo.	Giant Fig.	Red.	GM x B2.
Appearance of bunch.	Excellent habit when green; tendency to distortion of bunch when ripening.	Good bunch habit; elastic main stalk; tendency to disorderliness in late maturity.	Good when green; disorderly when ripe.	Good but heavy.	Neat.
Colour when ripe.	Good.	Very good.	Pasty greenish-yellow (sometimes good colouring).	Attractive claret colour.	Excellent, recalling Gros Michel.
Flavour.	Mediocre.	Mediocre.	Poor.	Mediocre.	Pleasing, but probably an acquired taste.
Texture.	Coarse.	Moderate.	Moderately good.	Coarse.	Very delicate.
Evenness of ripening.	Moderately uniform.	Uniform.	Very uneven.*	Highly uniform.	Highly uniform.
Disposition of fingers.	Fingers sag when ripening, giving disorderly appearance.	Tendency to sag.	Marked tendency to sag.	Finger-stem sufficiently fibred to hold fingers erect.	Fingers remain erect until advanced maturity.
Pre-disposition to mechanical injury and bruising.	Slight.	Slight.	Marked.	Very slight.	Very slight.
Speed of ripening of "¾-full" bunch at 70° F. after 14 days' cool storage.	8-13 days.	6-9 days.	10-14 days.	4-6 days.	4-6 days.

* May be due to nutritional factors—soil and climate.

The following conclusions could be drawn from the earlier storage trials of uncrated fruit :—

(1) From a consideration of bunch habit, attractiveness on ripening, flavour, &c., the varieties could be divided into two main groups :

(i) Gros Michel, Lacatan,* Cavendish—varieties of definite commercial possibility ; and

(ii) Those of doubtful commercial possibility. It should be noted that (I) the GM x B2 has a good flavour and texture and many desirable Gros Michel characteristics, but the unfortunate possibility of an occasional seed precludes its inclusion in the first group ; and (II) the Red banana behaves well in storage at both 55° F. and 60° F., and has been exported quite successfully. There is, however, not a large market for it, its chief attraction in competition with other varieties on the market being its rare claret-red colour.

(2) There seems to be a correlation between pre-storage nutritional factors of soil and climate, and the behaviour in storage and ripening. Our bananas are grown on patchy soils, and while, for the most part, we have not been consistently successful in the ripening up of several varieties, we have noticed that occasional vigorous bunches have ripened very attractively. This was particularly noticeable in the case of the Lacatan which had been kept at 60° F. during the cool storage period.

(3) The excessive tenderness and susceptibility to bruising usually associated with the Cavendish, *e.g.*; necessity for crating, were not borne out by these trials, though careful handling obviated the major objection, namely, the breaking off of the fingers, which tend to curl upwards and rather outwards.

(4) The majority of irregular colouring up of fingers and the premature ripening of lower hands, were found to be due to fungal attack as a result of insect punctures or mechanical damage during harvesting and transport.

3. Bulk Storage Trials.

As pointed out above, our earlier trials led us to regard the Lacatan and the Cavendish as possible substitutes for the Gros Michel. The Lacatan was left over for the time being, as until the newer extension plots come into bearing, the behaviour of this variety in bulk storage could not be undertaken. The Cavendish, on the other hand, is largely grown by Indian peasant proprietors throughout the island, and is widely distributed through the Windward and Leeward Islands. It is a dwarf plant, and is therefore more suitable to wind-swept sites. The importance of such work to the islands of the British West Indies, where, owing to the prevalence of hurricanes, a suitable annual crop is urgently needed to supplement a languishing staple crop, needs no further comment here.

Accordingly, bulk storage trials with the Cavendish variety were commenced, and up to the present we have conducted two. Fruit in sufficient quantities was procured to introduce the complex of bulk and consequent self-heating.

Care was taken to lessen as much as possible the interval between the reaping of the consignment and the commencement of refrigeration. On arrival at the Station, the bunches were conveyed into the air lock,* examined, and the stems cut and vaselined ; after this they were loaded into the storage chamber (air temperature 53° F.), in the typical way in which the Gros Michel is handled in bulk—in short, the layer of bunches on the floor was subjected to the weight of several tiers of fruit above it. The storage atmosphere was completely changed once daily, at 6 p.m., and determinations of the concentration of carbon dioxide were made, by means of the Haldane Gas Analysis Apparatus, at regular intervals.

By way of simplifying the description of results, the details of the two bulk storage trials are tabulated in Table II. (*See* overleaf.)

There is, therefore, a wide range of maturity under the trade term "three-quarters-full," at which the Cavendish banana may be picked, so that it will stand uncrated the usual bulk store conditions at 52.5° F. for as long as 18½ days. While on being ripened it has not the rich hue of the Gros Michel, the better and more vigorous bunches were extraordinarily symmetrical and attractive, especially before the onset of freckling, concomitant with late maturity in this variety. Even bunches which were thought to be too immature, ripened up to a product of pleasing flavour and appearance in 13 days. This would, of course, increase ripening costs.

If these results are confirmed in later storage trials, a hopeful note may be sounded regarding the possibilities of the West Indian Cavendish, as exemplified by the better-grade Trinidad fruit, as a substitute for the Gros Michel.

4. Observations on Fungi at the Low Temperature Station.

During the course of storage trials, the activity of various fungi became evident, fruit, finger-stems, and main-stems being affected to a greater or less extent. The collection of fungi isolated included *Thielaviopsis paradoxa* (De Seyres) Von Hohn. *Ceratostomella paradoxa* (Dade), *Gloeosporium musarum*, (Cke. and Massee.)

* Attention was drawn to the importance of this variety in our report, *E.M.B.* 20.

* While the use of an air lock is not practicable in large-scale shipments, it has nevertheless materially assisted us in the rapid cooling of our fruit. Under these conditions, our consignments have remained comparatively free from main-stalk rot, while the Trade's objection, namely, risk of chilling, was not experienced.

Botryodiplodia theobromae (Pat.), *Phomopsis* sp., *Acremoniella* sp., *Eidemia* sp., *Verticillium* sp., several species of *Fusarium*, and other fungi not yet identified.

Two mycological aspects received thorough investigation:

1. The rate of growth of the more important organisms at different temperatures.

2. Their parasitic behaviour as determined by inoculation experiments.

The several aspects of disease to which attention has been given, and which were reproduced by actual controlled inoculation experiments, may be described as follows:—

1. *Main-Stalk Rot*: *i.e.*, a downward rotting from the cut end of the main-stalk. This is the disease popularly described as Stem-End Rot, which causes trouble when fruit is removed from the holds at ports overseas. (*Thielaviopsis paradoxa, Botryodiplodia theobromae, Gloeosporium musarum.*)

2. *Local lesions of main-stalks*: Infections may become established at points along the main-stalk. Localised or spreading blemishes or cracks may result. (*Thielaviopsis paradoxa, Gloeosporium musarum, Phomopsis* sp.)

3. *Cushion Infections*: Isolated infections frequently become established on the cushions. According to the fungus involved, a limited blemishing or an extensive rotting, extending to finger-stalks and fingers, may result. (*Gloeosporium musarum*).

4. *Finger-Stalk Rot*: This type of localised infection on individual finger-stalks is fairly frequent, and may be the cause, or a contributory cause, of finger-dropping. (*Gloeosporium musarum.*)

5. *Finger Diseases* may become established at the distal end or at other points on the fruit skin. They sometimes result from a spread of finger-stalk rot to the fingers. (*Gloeosporium musarum.*)

Table 2.

Observations.	Bulk Trial No. 1.	Bulk Trial No. 2.
1. Number of bunches used	120	230*
2. Temperature of store after fruit has been cooled down	53° F.—for the last six days 52.5° F.	52.5° F.
3. Humidity of storage chamber	80-90 per cent.	85-90 per cent.
4. Time before air temperature: (*a*) (delivery)	23 hours	12 hours
(*b*) (return) was 53° F.	45 hours	19 hours
5. Number of days in cool storage	17	18½
6. Number of "ship-ripes"	2	Nil
7. Number of total rejects	Nil	1 (broken stalk)
8. Temperature of ripening room..	70° F.	70° F.
9. Number of attractive "ripes" in six days	50	137
10. Further attractive "ripes" by the tenth day	48	62
11. Number which failed to ripen	1	Nil

* Of this number, there were 30 poor, undersized bunches, which were included merely to make up bulk. These are not referred to in items 6, 8, 9 and 10.

5. Application to Transport.

Our earlier investigations at the Low Temperature Station indicated that decay of banana fruit during cool storage was referable to a plurality of organisms. Where fruit was carefully handled and placed in a cool chamber with the minimum delay, the amount of disease developed at the end of a storage trial was relatively insignificant, and seldom gave trouble in handling.

The next stage in the investigation was to consider the nature and incidence of diseases in large consignments of fruit during ocean transport. The following observations are the result of several visits at Port-of-Spain to fruit ships, through the courtesy of Messrs. Elders & Fyffes, Ltd.

Briefly, it may be stated that the organisms studied in our earlier storage trials were again isolated from diseased stem-ends of Colombian

fruit. Their growth rates at different temperatures were studied, and their pathogenicity demonstrated. It is important to note that *the amount of disease on Santa Marta fruit at the end of three days was greater than that developed in storage trials at the Low Temperature Station at the end of* 14 *days.* An explanation is readily to hand. Generally speaking, the interval between the reaping of Colombian bananas and the commencement of refrigeration, after closing the hatches and blowing out the air thoroughly for one hour, is approximately 36 hours, while this interval, in the case of our fruit, has seldom been as much as ten hours. During this period, while loading temperatures are in the vicinity of 80° F. to 85° F., fungal organisms have favourable conditions in which to establish themselves on the cut ends and commence growth. Great then as the initial advantage of a 36-hour period at ordinary temperature is, a further advantage is afforded these organisms during the rather slow cooling down of the cargo to 53° F. during the first four days of the voyage. The following interesting average temperatures were obtained on boat "B":—

Air Temp.	(delivery)	..	..60° F.
Do.	(return)	..	..63.7° F.
Flesh Temp.	fruit	..	..60.2° F.
Do.	stalk	..	..60.2° F.

These figures represent the temperature of the cargo at approximately 70 hours after the commencement of refrigeration. Our cooling system at the Low Temperature Station permits of more rapid cooling with the smaller consignments which we handle, and in consequence, considerably lower flesh temperatures are reached within 48 hours.

By way of confirming our diagnosis, a consignment of fruit was subjected to ship's condition in the matter of rate of cooling. They were accordingly brought to the laboratory, stem-ends were freshly cut, and some were inoculated with *Thielaviopsis* and the rest with *Botryodiplodia*—both of these cultures having been prepared from diseased stem-ends obtained on the boat. They were then left in the laboratory at ordinary temperatures for 36 hours, after which they were held successively for 24 hours at 70° F., for 48 hours at 60° F., and then transferred to 53° F. for the rest of the voyage period. Before the end of the period at 60° F.—the equivalent of the ships having reached Trinidad—the condition of the main-stalks recalled very strongly the state of affairs found on the ship. After a few days the characteristic stem-splitting became apparent in the case of stems inoculated with *Botryodiplodia,* and by the tenth day fungal penetration, in the case of *Thielaviopsis,* had progressed into the centre of the bunch! There is no necessity, therefore, to comment on the pathogenicity of these organisms when favoured with a long period at ordinary temperatures, supplemented by a comparatively slow cooling down of the cargo. This was further corroborated by the growth curves of several of the organisms in petri dish culture under similar conditions.

Determinations showed the carbon dioxide concentration to be surprisingly low, and when considered in the light of the self-heating of fruit in bulk (90,000 bunches), is a tribute to the efficiency of the fans and ventilation system of the banana boats.

6. Recommendations regarding Main-Stalk Rot.

There seems little doubt that the financial losses attendant on main-stalk rot will be very considerably reduced by :—

1. When reaping bunches, stalks should be cut long—at least ten inches. (Vide 2 below.)

2. The application of the vaseline treatment. When a bunch has been passed for shipment after final inspection at the quayside, the stem-ends should be freshly cut with a sharp instrument and thoroughly vaselined. In this way the fungal organisms which have become established in the long interval between reaping and loading, will be eliminated.

3. Commencing refrigeration as soon as possible after loading. As soon as a deck has been loaded, it should be sealed up by means of efficient baffles, the air thoroughly blown out, and refrigeration commenced without further delay. (The arrangement of the air trunks on some boats may be such that this procedure would involve waste of refrigeration, but the improved state of the cargo on arrival overseas should compensate adequately.)

4. Rapid cooling of the cargoes. It should be the aim of the boats' refrigeration staff that, within 12 hours at the most, the fans deliver cold air at 53° F. *Under similar conditions, no chilling effects were recorded in our transport trials.*

5. On arrival at ports overseas, fruit which has been adversely affected with main-stalk rot should be ripened as expeditiously as possible. Known ripening activators—ethylene, coal gas, volatile citrus products—should be used. On no account should "forced" ripening by temperatures higher than the usual banana ripening temperatures be resorted to.

7. Paper Bag Experiments.

The use of crates, containers, blanketing, &c., has been repeatedly resorted to in the export of varieties which experiment had shown to be unsuited to transport under the customary Gros Michel conditions of treatment. It will be readily conceded that with a variety like the Gros Michel, which is not so pre-disposed to bruising, the use of an envelope of smooth brown paper makes possible the transport, and arrival at destination, of fruit, with the absolute minimum of bruises, scratches, &c. On ripening to its characteristic rich colour, the resulting product is of surprisingly attractive appearance. Several points, however, call for comment.

While these bags are not intended to be airtight, having a hole at the bottom through which the lower end of the stalk passes, and being tied up

with string at the other end, they nevertheless offer serious resistance to the passage of cold air through them, with consequent interference to :

1. The cooling down of the fruit inside them. The relation between main-stalk rot and temperature has been discussed fully above.

2. The removal of the volatile products emanating from the fruit.

In short, the use of such bags affects very materially two important inter-dependent variables of the storage chamber, namely, temperature and composition of the atmosphere. Actual measurements showed that while the ordinary air temperature of the holds was 60.8° F., the average air temperature within the bags was 67.4° F.—nearly 7° F. higher. These observations were made in bags as far removed from the margin as one could conveniently reach without unduly disturbing the cargo. But what conditions obtain in the centre of the pack !

While an atmosphere comparatively richer in carbon dioxide, with correspondingly subnormal oxygen concentration, is known to slow down the maturation process, it is doubtful whether this effect, in the case in point, would not be counteracted by the higher temperature, in terms of Van't Hoff's law of rate of chemical reactions. Support is lent to the view by Olney[1], who showed that a temperature of 53.6° F., respiration in the banana proceeded at one-third of the rate at 68° F., and by Kidd and West[2], who point out the undoubted correlation between activity of respiration and length of storage life. It would, therefore, be interesting to know at what rate these bunches are cooled, as judged by flesh temperatures. In stored apples, the presence of high concentrations of carbon dioxide is responsible for the incidence of a functional or non-parasitic disease, known as Brown Heart.[3] Light will be thrown on the question of inimical concentrations in the course of work in progress on the behaviour of the banana in atmospheres of varying partial pressures of carbon dioxide and oxygen at different temperatures.

It was thought that a simple modification* might accrue to advantage. Accordingly, a number of bags were punched with holes, three-eighths of an inch diameter set four inches apart. These holes would, of course, tend to weaken the bags, especially in the case of fruit bagged in a surface-wet condition, but doubtless this objection might be over-ruled by the choice of paper of suitably resistant texture. The behaviour in storage and ripening of representative fruit in bags with, and without, holes, was compared. The superiority of the former was clearly demonstrated by :—

1. While over 60 per cent. of the bunches in the unpunched bags showed acute main-stalk rot, there was an incidence of six per cent. only in the corresponding punched set.

2. Cooling in the former was more rapid; during the first 24 hours of storage, the average difference between the air temperatures within the bags, punched and unpunched, ranged consistently between 2° F. and 2.3° F. These figures are significant, when the rate of cooling of our small consignments is realised, and enables one to form some impression of the magnitude of improvement possible in a large cargo of 30,000 bagged bunches or more, especially as the chief object of the bagging process—the prevention of bruising—was not perceptibly defeated by the presence of these small holes.

8. Crated Fruit.

In the East, the greater part of the banana trade, except for very short distances, is carried on in crates, the bunches being cut up into hands before being crated. In anticipation of inquiries from British Colonies interested in this trade, the question of crated bananas has been given a good deal of attention.

The main difficulty encountered is the tendency to unevenness of ripening within the crates, coupled with the fact that the fruit tends to ripen comparatively more quickly when cut into hands than when left in the bunch. For example, the breaking of the stem towards the lower part of the bunch has frequently been observed to cause premature ripening in the lower hands.

Unevenness of ripening may be attributed :

1. To uneven temperature within the crates.

2. To the crating together of fruit of different stages of maturity at time of harvesting.

3. To the fact that the normal ripening of a bunch proceeds progressively from the top, or first formed hand, downwards towards the lowermost, and thus, under similar conditions, one would expect different rates of ripening in the different hands of the same bunch, provided, of course, that the temperature were not sufficiently low to inhibit the natural functioning of the ripening enzyme (or enzymes).

4. To the incidence of fungal diseases.

Experimental work was carried out with a view to eliminating these difficulties. The results show convincingly the importance of pre-cooling the whole bunch prior to cutting into hands and crating. *To the best of our knowledge, such pre-cooling of the whole bunch has not hitherto been attempted as part of routine procedure—its adoption should very materially benefit the crated industry.*

(1) Olney, A. J.—The Temperature and Respiration of Ripening Bananas. *Bot. Gaz.*, 1929. Hull Botanical Laboratory, 361.

(2) Kidd, F. and West, C.—*Food Invest. Board, Annual Report*, 1927.

(3) Kidd, F. and West, C.—"Brown Heart"—A Functional Disease of Apples and Pears. *Food Invest. Board, Special Report*, No. 12, 1923.

* We have learnt through London correspondence of 11th April, 1930, that the British Banana Company (Vestey) have found the use of bags with holes of one inch diameter an improvement.

This pre-cooling of the whole bunch serves a further useful purpose in the case of fruit to be handled in a surface-wet condition. This condition is not of itself harmful. As a matter of ordinary procedure, bananas transported in the "naked" condition are subjected to the drying action of rapidly circulating air, shortly after loading; in the case, however, of fruit crated in a surface-wet condition without pre-cooling, the matter is very different. High temperatures, which are often the rule towards the centre of the cargo stack, in conjunction with the high humidity introduced by wet fruit, favour the growth of rot organisms so often responsible for the considerable wastage in, and unsightly appearance of, banana cargoes.

In conclusion, our investigation of the storage behaviour of the banana crated in hands, emphasises strongly the necessity for:

1. Careful selection of fruit at the correct stage of maturity. (This will be governed chiefly by the length of voyage.)

2. Shortening as much as possible the interval between reaping and transference to the cool storage chamber.

3. *Thorough pre-cooling of the whole bunch prior to cutting into hands.* For journeys of ten days or longer, the vaseline treatment is strongly recommended.

4. Rapid transference, in insulated conveyers if necessary, from the pre-cooling station into the ship's hold.

5. The maintenance of a temperature of 53 to 55° F., in the case of Cavendish and Gros Michel.

6. The complete change of the storage atmosphere at least once (preferably twice with large consignments) per day.

7. The use of "dunnage" on crates, and the provision of vertical breaks in the cargo stack, when these are large.

9. Concluding Observations.

1. The behaviour in storage, and during ripening, of a number of immune varieties, as a possible substitute for the Gros Michel, was studied. The Lacatan and the Cavendish alone seemed promising as judged by commercial criteria.

2. The Cavendish variety, in the course of bulk storage trials, gave promising results. If these are confirmed in later storage trials, the West Indian Cavendish, as exemplified by good Trinidad fruit, seems a suitable substitute for the Gros Michel.

3. Main-Stalk Rot has been shown to be due to a plurality of organisms. The more important of these have been isolated in pure culture, identified, and their growth rates at different temperatures and their pathogenicity demonstrated.

4. Definite measures for the prevention of Main-Stalk Rot have been put forward.

5. With regard to the transport of bananas in paper wrappers, perforated bags have been shown to allow of more rapid cooling and more efficient ventilation.

6. Measures for the reduction of wastage in, and the improvement of, crated cargoes of bananas, have been submitted. The importance of pre-cooling the bunch before cutting into hands, cannot be emphasised too strongly.

INSTITUTE OF PLANT INDUSTRY.

THE report of the twentieth meeting of the Indian Central Cotton Committee, contains several matters of scientific significance. The interest taken by leading industrialists in India in the scientific development of agriculture is exemplary. The work of the Institute of Plant Industry has impressed Indian industrial leaders and ministers so much that large sums of money have been given to develop the new variety of Malvi cotton which the Institute has selected, and to put into practice the suggestions made by the Institute for the improvement of agriculture generally. This interest may be illustrated by the following extract from the report of the speech of the Prime Minister of the Holkar Government at the meeting: "We must naturally proceed slowly and only take up improvements and new ideas after they have been carefully considered and also carefully tested by scientific investigators whose experience, performance, and standing carry weight." This statement shows that the important part which science plays in industrial development is thoroughly understood by some Indian leaders.

We find later in the report that the Committee's plans are widening to include the cotton manufacturing industry. A few years ago the Committee built the Cotton Technological Laboratory at Matunga, Bombay. The laboratory has a large and capable scientific staff and is well equipped with modern apparatus and a complete spinning plant. The standardisation of Indian cottons was its primary function, but its recent bulletins have included investigations in the technology of cotton spinning which are noteworthy contributions to this branch of applied science. Again, Indian industrial interest has been stimulated by the work of a scientific laboratory with the result that it was decided at the Indore meeting to extend the work to meet the requirements of the mill industry and the cotton trade generally. This step now brings within the control of the Indian Central Cotton Committee the scientific development of all branches of the Indian cotton industry, from the selection and raising of the crop to the production of the finished article. The Committee is to be congratulated on its foresight, and all scientific men will appreciate its efforts to apply scientific control to the development of the Indian cotton industry.—(*Nature*, Vol. CXXV, No. 3143.)

SEA ISLAND COTTON.

By John A. Todd.

The Sea Island crop of the West Indies has passed through many vicissitudes in its time. About 150 years ago, before America had begun to grow cotton in any volume, the West Indies were one of the chief sources of Great Britain's supply of fine cotton; but when early in the 19th century the American crop acquired its dominance of the world's supplies all other supplies sank for a time into comparative insignificance. In the meantime the *Barbadense* variety had been transplanted in 1786 to Charleston, South Carolina, where it became a substantial crop, the record being nearly 120,000 bales in 1911. Here also it acquired its name of Sea Island cotton from the so-called "Islands," on which it grew best, off the coast of South Carolina; and here it ultimately established its reputation as the very finest cotton in the world. Towards the end of the 19th century, however, the American Sea Island crop had to face the competition of the new Egyptian varieties, Abassi and Jannovitch, which were about as good as the lower grades of Sea Island cotton grown near the coast in Florida and Georgia from supplies of seed constantly renewed from the real "Islands" crop.

At the beginning of the 20th century it was again carried back to the West Indies, as the result of the great depression there arising from the economic failure of the sugar crop, due to low prices resulting from the competition of Continental bounty fed beet sugar; and since then the history of the West Indies crop may be summed up in the varying fortunes of its competition with sugar. Even when the complete failure of the American Sea Island crop in 1918 gave the West Indies the practical monopoly of the world's supplies of the finest cotton, the effects of the war still made sugar a very strong rival; and until a few years ago the cotton industry was in a very depressed condition partly owing to the apparent failure of demand, and partly owing to the invasion of the pink boll worm.

In the last year or two, however, there have been distinct signs of a revival, and as this happens to coincide with another period of acute depression in the sugar industry, the question of the relative advantages of the two crops in the West Indies has again come to the fore. As the conditions which affect the problem are rather complicated it is worth while to restate them in some detail. The changed conditions relate both to supply and demand. On the supply side the main factors may be described as both botanical and agricultural. The introduction of certain new varieties, especially the Heaton type in Montserrat, has resulted in a marked improvement in the economics of the crop, for these varieties are not only a very desirable type of cotton, being not quite so superfine as the very best of the old "Islands" types of which small quantities were produced in St. Vincent and elsewhere, but they are also heavier yielders, which is a very important consideration in the question of cost of production. At the same time there have been other developments also in the direction of increased yield. In certain of the islands a change in the growing season has proved very beneficial, and finally the apparent success in controlling the attacks of pink boll worm has opened up a more hopeful prospect for the growing of cotton under conditions of improved average yield, especially in the direction of the possibility of a second picking.

This question of improved average yield and reduced cost of production is of the first importance because it must be realised that the demand for Sea Island cotton is largely a question of price. It is admittedly a luxury article and possesses to some extent an exclusive market of its own, in which perhaps the price matters less than it does in the case of other varieties; but it is a mistake to suppose that its monopoly is so complete as to make it quite independent of the competition of other varieties. The position should rather be put in this way, that Sea Island cotton occupies a rather lonely position at the top of the ladder of quality; but the ladder is there, and as a matter of fact the greatest drawback from which Sea Island has suffered recently in the world's cotton market is that its price was so high that demand stopped short altogether before reaching it, and it has been left in a position of anything but splendid isolation. The best illustration is the fact that when the American Sea Island crop was wiped out about ten years ago, the chief users of Sea Island cotton in the lace trade found themselves able to shift bodily over to Egyptian Sakel cotton, and Sea Island was practically never missed. The result was that since then Sea Island has been left severely alone by the cotton trade as a whole; and even the small total of about 5,000 bales to which the world's supplies had sunk has often proved to be more than the world wanted at the price. The planters have found their crops left on their hands for a year and more almost without a bid, and stocks accumulated to such an extent that the planters were thankful to have them taken over by English spinning interests at prices which were very far from satisfactory to the growers, and were only accepted because they were better than nothing. The result, of course, was a strong agitation for a still further reduction in the supply, but just before that had any chance to be generally effective conditions began to improve again, and in the last few years the crop has moved off more readily and at fairly good prices.

The explanation of this improvement in the demand lies just in the recognition of the fact that Sea Island cotton has its place among the fine cottons, and that if it can be sold at a competing price there is a demand for it. The writer has recently been endeavouring to trace the source of this improved demand and the results at present available all point to the fact that the demand

for Sea Island cotton is something just a little above that which can be supplied by the best Egyptian varieties. Thus in the lace trade, where of course a great deal depends on changing fashion, the section which most largely uses Sea Island cotton is the one section which has been the hardest hit by the depression that has hung over the lace trade since the war. The recent comparative recovery of the lace trade has been almost entirely in other sections of the trade which could use Sakel instead of Sea Island, so that the demand for Sea Island yarns for lace has not had its full share in the recovery of the trade. But there is still a small trade in those sections which do require Sea Island, and small quantities of good Sea Island yarns are still in steady though almost infinitesimal demand. Again in the finest woven fabrics there has recently been a fair increase in the demand for the very finest fabrics in which Sea Island is used either mixed with Egyptian or alone.

But the total demand under these heads is very small, and it is in another direction that the only hope lies of a more substantial demand for Sea Island yarns, namely in the fine stocking trade. The fashions of recent years have created an enormous demand for ladies stockings of the finest possible texture, but this demand was at first confined to silk, and latterly the introduction of artificial silk seemed to have excluded the possibility of any return to fine cotton stockings. Quite recently, however, there have been signs of a reaction against artificial silk, and the chief cause of this is to be found not so much in the raw material as in the method of manufacture. Cheap stockings were mainly of the seamless type, and these were made on a circular machine in tubular form which does not allow of the proper shaping of the leg. Full-fashioned hose on the other hand, were made flat and could be shaped in such a way as to fit the leg exactly. But the machines on which these full-fashioned hose were made were small and slow, with the result that the output was small and expensive, and as the cost of manufacture was very high it was not worth while to use a cheap material. Ladies would not pay the price of the fashioned article for a cotton stocking.

These fine full-fashioned goods were mostly of German manufacture, for the Germans had specialised in fine gauge machines to produce them, while English manufacturers were content with their existing trade in the coarser gauges. Within the last year or two, however, a number of English manufacturers have been buying the latest types of German machines, some of which are of enormous size and are capable of making 24 stockings at once. These machines were at first intended for the silk trade, but that trade within about the last 12 months has been very hard hit, and there is just a chance that this may prove to be an opportunity for very fine cotton goods. Woman's view has been coming round to the point that, if they want a cheap stocking, a full-fashioned article of fine cotton is better than a non-fashioned artificial silk stocking. The result has been a marked revival in fine lisle or chiffon lisle hose, and some makers have re-introduced Sea Island cotton for this purpose. It is believed that the development of this trade has been greater in America where the fashion for "sheer" hose was always very marked; and this may be the explanation of the fact that since last year there has been quite a definite demand for Sea Island cotton, especially in Montserrat, from America. That cotton has gone to the fine spinning mills in the Gastonia district of North Carolina where hosie y yarns are largely made, and it is possible that this may be the beginning of a trade which will develop to quite an important extent. On the other hand, however, it may prove to be only a passing fashion, especially with the return of longer skirts. That is a matter on which the writer would carefully guard against expressing any opinion until further information is available.

But the point which the Sea Island growers must keep in view in all this is that, even if this trade should grow, it by no means follows that the goods will all be made of Sea Island cotton. On the contrary, not only is Egyptian quite good enough for the bulk of the trade, but as a matter of fact a large proportion of the so-called Sea Island stockings are actually made from Egyptian cotton, and the question is one entirely of price. If Sea Island cotton does not cost very much more than the best Egyptian, it will be used for the best grades of the trade, but the difference in cost must not be very heavy. The writer was recently shown two samples of 100's two-fold yarns intended for a very fine shirting; the one was super-combed Sakel and the other Sea Island, and no one but an expert would have known the difference. But the difference in price was 18*d.*, the Sea Island yarn being about 30 per cent. dearer than the Sakel. Such a difference is fatal and is not justified by the superior quality or the greater cost of production of Sea Island cotton. It is true that Egyptian prices have recently been unduly low in company with American, while Sea Island has been much less affected by the recent slump; but manufacturers will not pay anything like that difference and the Sea Island growers must realise this. The policy that will pay them best is to produce their fine cottons at the lowest possible price and sell them more readily and in greater volume.

At the same time it cannot be too strongly emphasised that any large increase of the supply of Sea Island cotton in the immediate future would be a mistake. The recent improvement in the demand is still too slight and too uncertain to justify more than a very moderate addition in the supply. Some of the Islands which had almost dropped cotton may find it worth while to revert to about the former amount of their crops, but any large increase would certainly be premature.

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STUDENT INVESTIGATIONS.

THE following is a list of some of the papers prepared by students while in residence at the College. These are available in the College Library for reference.

1928-1929.

C. G. AKHURST, A.R.C.S., B.SC. (Lond.), and R. G. H. WILSHAW, B.SC., B.A. (Oxon.).	A Study of some Cacao and Forest Soil Profiles in Trinidad.
W. COOK, Nat. Sc. Trip., Pts. I and II (Cantab.)	(1) Some Notes on the Plant Associates and Habitat of *Clidemia Hirta*, D. Don, in Trinidad. (2) An account of the Life History of *Liothrips Urichi*, Karny, a Thrips attacking *Clidemia Hirta*, D. Don, in Trinidad.
C. W. L. FISHLOCK, B.SC., Agric. (Read. and Lond.), and R. L. KNIGHT, B.SC., Agric. (Lond.)	Cotton Selection.
R. H. FRASER, B.SC., Agric. (Edin.), and F. R. SANDERS, B.A., Dip. Agric. (Cantab.)	The Labour Supply of Sugar and Cocoa Estates, Trinidad.
E. W. GADDUM, B.SC., Agric. (Lond.) and R. D. Linton, B. Agric. (Belfast)	Insect Control in Stored Grain.
A. V. GIBBERD, N.D.A., N.D.D., Dip. Agric. (Read.), and A. E. TROTMAN, N.D.A., Dip. Agric. (Harper Adams)	An Investigation on the Soya Bean in Trinidad.
T. R. HAYES, M.SC. Tech. (Manchester)	(1) A Study of the Effect of Different Plot Environments on the Growth of Two Varieties of Sugar-Cane. (2) The Effect of certain Chemical Treatments on the Sprouting and Growth of Sugar-Cane Cuttings.
B. J. HARTLEY, N.D.A. ..	..*Coix Lachryma - Jobi.*
R. LEACH, B.A. (Oxon.), and J. WRIGHT, 1st Class Hons. Botany (St. Andrews)	(1) The *Fusarium* Wilt Disease of Sunn Hemp. (2) Collar and Stem Canker of *Cajanus Indicus* (Pigeon Pea), caused by a Species of *Physalospora*.
A. C. MAHER, B.A., Dip. Agric. (Cantab.) and A. N. PRENTICE, B.SC., Agric. (Edin.)	Maize Selection at the Imperial College, 1928-1929.
J. A. McDONALD, Dip. I.C.T.A., A.I.C.T.A.	Experiments with Final Molasses.
A. PICKLES, 1st Class Hons. Zoology (Leeds), and C. A. THOROLD, B.A. (Oxon.)	An Investigation into certain Diseases of Cow Pea (*Vigna catiang* Walp) and Woolly Pyrol (*Phaseolus mungo* L.), and the Fauna associated with these crops in Trinidad.
J. ROBERTSON, B.SC., Agric. (Aberdeen)	Inheritance in *Stizolobium*.
A. C. DE SILVA, B.SC., Agric. (Lond.), C.D.A.	Millet *Eleusine coracana* Variety Yield Trials, 1928-29.
A. S. THOMAS, B.SC., Hort. (Lond.)	..An Investigation of Variability among Seedlings of Cocoa.
R. TURNER, B.SC. Agric. (Edin.)	..An Investigation into the Possibilities of substituting Mechanical for Hand Labour in Trinidad.
J. WEST, B.S.A. (McGill), and R. W. STUCKEY, M.A. (Cantab.), B.S.A. (McGill)	..The Parasitism of *Macrophomina phaseoli* (Maubl.) Ashby.
J. McN. WINGATE	..Botanical Studies in Connection with Cotton Selection.

TROPICAL WORLD NOTES.

Somaliland.

Somaliland has an area larger than England and Wales, and from the point of view of the Agricultu al Department, the Protectorate may be divided into two main classes of country, namely, nomadic pastoral lands (which there is some justification for regarding as permanently grassed, and on which large numbers of sheep and goats are annually reared), and the areas which are cultivated for the production of crops, chiefly sorghum. One product which may possibly turn out to be of considerable value is fibre. (Early in 1929, an application was made and granted for the exploitation of Hig (*Sansieveria Ehrenbergii*), the fibre plant which grows wild over large areas of the Protectorate. Up to the end of the year no active operations on the concession had been undertaken.) In view of the proximity of the Sudan and its valuable gum trade, the Protectorate authorities are naturally devoting much attention towards the possibility of establishing a similar industry in Somaliland. With this object in view a trial shipment of gum was sent to a well known firm who reported that although it was not suitable, owing to its gelatinous nature, for confectionery purposes, a better product could probably be obtained by more careful collection, particularly by organised tapping of the trees.—(*African Industries*, Vol. XX, Nos. 25 and 26.)

* * *

Virgin Islands.

According to the 1928 *Report of the Agricultural Experiment Station*, the agricultural and economic situation in St. Croix was better at the close of the year covered by this report than it has been since the decline in the price paid for sugar in 1920-21. Rains throughout the summer of 1927 stimulated cane planting, resulting in a good yield and providing employment for all desiring it. An increase of 50 per cent. in the wages paid field labourers not only helped to improve their condition in particular, but also caused more money to be put into circulation than formerly, and thus improved economic conditions in general. Further change was brought about in the labour situation through the importation of plantation labourers from Porto Rico. A common complaint against the labourers of St. Croix has been their almost universal practice of absenting themselves from work on several days during the week. In an effort to improve the situation the station six years ago decided upon the plan of paying its labourers on a fortnightly basis. To each field labourer who works every day in the month, excepting of course Sundays and legal holidays, a bonus of five cents per day is given. This method has proved to be of benefit both to labourers and employer. The labourers are encouraged to work regularly and are paid for a greater number of days at a better wage than was the case under the old method. The station, on its part, is able to plan its work in advance with the certainty that the labour force will not be seriously diminished by a number of absentees. It is significant that of 204 possible bonuses—that is, 17 labourers for 12 months—139 were paid during the year. Of the total field force, the average number of men per month who worked every day was 68 per cent. Work at the station has been chiefly confined to animal husbandry, poultry breeding, truck crop tests, and the study of sugar-cane varieties. Nine new kinds were introduced and several others are being grown in quarantine in St. Thomas pending their shipment to St. Croix. Approximately 4,532 new seedling varieties have been developed within the past three years of which 1,182 are under test. The total yield of sugar in St. Croix for the season 1927-28 was estimated at about 12,000 short tons; the crop occupying approximately 6,000 acres of land. Attention has also been paid to the problems connected with the shipping of vegetables to New York.

* * *

Leeward Islands.

Details relating to the trade and production of the Leeward Islands (Antigua, Montserrat, St. Kitts-Nevis, Dominica and the Virgin Islands) are contained in *Colonial Report* No. 1468. In Antigua the export of sugar in 1928 amounted to 18,906 tons, valued at £245,788, in addition to which 529,800 gallons of vacuum pan molasses, and 43,500 gallons of fancy syrup were shipped. Cotton and lime products are also other items figuring fairly prominently in the export trade, which for the year totalled £259,100, of which purchases by the United Kingdom amounted to £202,450. In 1928 the total value of exports of St. Kitts-Nevis was £349,645, of which sugar (18,610 tons) accounted for £265,490. Sea Island cotton is a valuable product of St. Kitts-Nevis, and in 1928 this was exported to the extent of 438,552 lb., valued at £36,038, all of which went to the United Kingdom. Dominica is well known for its large production of limes and lime products, exports of which in 1928 amounted to £119,514, the items including concentrated and raw lime juice, lime juice cordial, fresh and pickled limes, essential oil and otto of limes. Raw and concentrated juice goes mainly to Great Britain, the United States taking the bulk of the shipments of lime oils and green limes. Other products grown in Dominica are coconuts, cocoa, coffee and vanilla, and there has been an increase of late years in exports of copra to the United Kingdom. Montserrat, which does a much smaller trade than the foregoing islands, exports chiefly cotton lint, lime products, onions, and bay oil. Total exports for 1928 amounted to £86,599, and shipments of cotton lint at 863,025 lb., valued at £74,637 were the largest ever recorded for Montserrat. In the Virgin Islands efforts are being made to encourage cotton cultivation among the peasants, although it is felt that there is great need for some staple crop to replace it. Tobacco is grown and cured, but in regard to agricultural production generally, there seems to be a peculiar apathy on the part of the islanders.

ENTOMOLOGICAL NOTES.

Compiled by the College Department of Entomology.

Snakes and Termites—A New Example of Symbiosis.

Certain snakes have been found to occur in the nests of termites; even great pythons as well as a species of *Typhlops* occasionally inhabit the mounds of *Termes bellicosus* on the Gold Coast and elsewhere. Lizards have gone even further, and several South American species are known to deposit their eggs in or on termitaries suspended in trees. Up to the present, the egg-laying habit has not been observed in termitophile snakes, and Dr. F. Kopstein's discovery, during an expedition to West Java, adds a notable item of information (*Treubia*, June, 1929, p. 467). From a nest of the termite, *Lacessititermes sordidus*, found on a tree three metres from the ground, he saw a small newly hatched snake issue, and in the course of the evening four were found to leave the nest. The snake belonged to a rare species, *Dipsadomorphus jaspideus*, and its newly hatched young had probably never been seen before, but the most interesting point was the association with the termitary. An examination showed that in the centre of the nest, which measured 20 cm. in diameter, were six egg-membranes which still contained fresh white-of-egg. Each egg lay in a cell of its own, encased in a capsule of the material used in the building of the nest. The outer layers of the nest showed no trace of an opening through which a snake of the size of the adult could have entered to deposit the eggs, and the author is of opinion that the eggs were laid in the nest at an early stage of its growth, the termites continuing to build their structure around them. The advantages of the snake are obvious: a high temperature, high and constant humidity for the development of the eggs, and for the young snakes abundant food if they chose to live upon termites, which is not at all certain.—(*Nature*, Vol. 124, No. 3129.)

* * *

Tick Parasites.

In *Science* (Vol. LXXI, No. 1842) a summary appears of the 1928 African tick parasite expedition of the Montana State Board of Entomology which was organised to collect information on tick destroying parasites and particularly to find a parasite that could be used in the control of the Rocky Mountain spotted fever tick, *Dermacentor andersoni* Stiles. As many ticks as possible from all kinds of domestic and wild animals were collected and held under observation alive to determine whether parasites were present. Headquarters were made at the Veterinary Research Laboratory at Onderstepoort, Transvaal, and collecting trips made to various parts of the Union of South Africa and also in Kenya. Well over fifteen hundred animals were examined, including many large and small wild animals, and approximately eight hundred tubes of ticks, including some thirty-four species, were collected. An *Ixodiphagus*, closely related to and possibly identical with *I. caucurtei* Du B. of France, was discovered preying on *Hyalomma aegyptium* L. in the Transvaal. This parasite was recovered several times and for the first time it was possible to make a study of an *Ixodiphagus* in a colony of the insects under natural conditions. Six days after sailing from Durban *en route* to Mombasa a chalcid which attacks adult ticks was discovered by Dr. G. A. H. Bedford. Some weeks later, on the occasion of a visit to South Africa, Dr. Robinson, Cooper's parasitologist, when told of the parasite work now being done in South Africa, stated that some years ago he had received a box of adult *Amblyomma hebraeum* Koch from Cape Province and on arrival in England the box was found to contain adult chalcids which had emerged in transit. He further stated that the insects were evidently of a species different from the one discovered by Dr. Bedford, which Dr. Robinson had an opportunity to examine. This chalcid likewise has not been named or studied. It is therefore reasonably certain that there exist in South Africa two new chalcid parasites of adult ticks which there was no opportunity to study. Through Mr. C. B. Philip, of the West African Yellow Fever Commission, Rockefeller Foundation, Lagos, Nigeria, Africa, it was learned also that a colony of an unidentified tick parasite in Nigeria had been discovered.

* * *

Crocodiles and the Tsetse Fly.

African crocodiles can harbour a form of sleeping sickness from the tsetse fly, but this is not the human type. The crocodile gets the disease by sleeping with his mouth open, thus permitting the flies to walk around and bite the soft membranes exposed. The disease is not transferred in the bite, but may be transferred if the beast wakes up irritated and snaps at the flies, thus crushing them and swallowing the parasites or germs carrying the disease. This particular germ requires the crocodile and the fly to complete its life cycle just as a malarial parasite requires man and the mosquito. These facts were determined by Cecil A. Hoare, of the Wellcome Bureau of Scientific Research, in a study on crocodiles made at the Human Trypanosomiasis Research Institute at Entebbe, Uganda.—(*Science Supplement*, Vol. LXX, No. 1824.)

COLONIAL APPOINTMENTS.

The following appointments and transfers have been made during the month of March, 1930, by the Secretary of State for the Colonies:—

Mr. E. A. Lewis, M.Sc., Ph.D., Entomologist, Tick Survey, Kenya.

Mr. R. B. Allnutt, District Agricultural Officer, Tanganyika Territory.

Mr. C. K. Latham (District Agricultural Officer, Tanganyika Territory), Senior Agricultural Officer, Tanganyika Territory.

Mr. A. S. Richardson (District Agricultural Officer, Tanganyika Territory), Senior Agricultural Officer, Tanganyika Territory.

Mr. A. J. Wakefield (District Agricultural Officer, Tanganyika Territory), Senior Agricultural Officer, Tanganyika Territory.

CHEMICAL NOTES.

Compiled by the College Department of Chemistry and Soil Science.

Whale Oil in Margarine Manufacture.

Whale oil, hardened by a hydrogenation process may be obtained with a high and uniform degree of purity. Such properties make it a valuable raw material for margarine manufacture, superior in some ways to vegetable fats. Its high melting point, however, prevents more than a small percentage being used in the margarine mixture. If unlimited quantities are used the production of a suitable emulsion is difficult. An apparatus invented by a Danish engineer overcomes this difficulty and simplifies the whole manufacturing process. The mixture of raw materials is emulsified by pressing it at a suitable temperature in the space between two concentric cylinders which are revolving rapidly in opposite directions. The resulting emulsion is automatically transferred to another revolving surface kept at a somewhat lower temperature. It is expected that this invention will result in large quantities of whale oil being substituted for vegetable oils in margarine. — *Ind. Eng. Chem.*, New Ed., Vol. VIII, No. 3.)

* * *

New process for curing beans.

Under the heading Special Investigations in the *Report on the Federal Agricultural Department of the Leeward Islands*, 1928-29, it is stated that at the request of a cocoa planter an attempt was made to cure a small quantity of beans by Stevens' process. The originator, F. L. Stevens, Professor of Plant Pathology at the University of Illinois has found that beans can be cured under aseptic conditions by heating at a temperature high enough to kill the embryos, but not high enough to injure the oxidases followed by further heating at a temperature high enough to inhibit the action of bacteria yeasts or fungi, but again too low to affect the oxidases. In the experiments conducted at the Federal Laboratory, plump well coloured beans were produced, but the flavour was considered to be somewhat harsh. Further experiments will probably be carried out.

* * *

Sisal Waste.

Advices from Kenya which have reached the Commissioner to the East African Dependencies Trade and Information Office in London state that experiments are at present being carried out in the colony for the purposes of obtaining fibre from sisal waste by the use of a newly designed tearing and scutching machine, and that the extraction of fibre from the waste in the experiment has amounted to as much as 60 per cent. It is added that if, as seems most improbable, the right type of machine can be devised, there are even hopes in the industry that the value of the recovered fibre from the waste would go a long way towards meeting the whole of the running expenses of an average sisal estate.

The Recovery of Coconut Oil by the use of Bacteria.

The compression process for recovering vegetable oils from the raw material tends to be wasteful and inefficient. However good the compression, a proportion of the oil-containing cells remains unbroken unless the raw material is previously subjected to an undesirable heating process. A more efficient method would be to dissolve or decompose the cell walls and thereby liberate the oil. Chemical reagents necessary to dissolve the cellulose and protein forming the cell wall would be sufficiently drastic in action to affect the quality of the contained oil. A bacterium *Bacillus delbrueckia* which can be obtained from brewer's malt has been used to decompose the cell walls. It has the advantage of being hardy, vigorous, anaerobic and thermophilic. It decomposes carbohydrates, forming lactic acid and an enzyme which hydrolyses proteins into water-soluble amino acids, but it has no action upon fats.

Copra is disintegrated, mixed with ground limestone and a little water to form a mush, and a culture of the organism is added. The mixture is placed in a large incubator kept at 50° C. from which air is excluded. Carbon dioxide is evolved, and lactic acid, which is immediately converted to calcium lactate, is formed by the action of the organism on the cell walls. The process is complete in about six days, when fermentation ceases. The liberated oil is separated from the residue by filtration.

The bacteria work in an acid medium of about pH 4.2 which is maintained by the interaction of the calcium carbonate, the lactic acid and the carbon dioxide. Although the high temperature practically sterilises the mixture against other organisms, it is advisable to keep the action strictly anaerobic. If molds are allowed to grow lipases will be produced which will act on the oil to form free fatty acid, and a low grade product will result. By careful control of the conditions a high grade oil with an acid value very little higher than that of the original oil can be obtained.

The chief disadvantage of the method appears to be the length of time required for the process, necessitating a very large incubator space. Nevertheless, it is claimed that the plant is cheaper to erect and maintain than that required for the compression process.

The solid and aqueous residues from the filter presses are converted to cattle cake. The former is dried and the latter is evaporated to dryness, and the two residues combined. The final cake contains any excess of calcium carbonate, calcium lactate, bacterial residues, amino acid derivatives, some unaffected cellulosic matter, and five per cent. of fat.

It is claimed that other oils may be extracted from their raw materials in a similar way by slightly varying the conditions.—(*Ind. and Eng. Chem.*, Vol. XXII, p. 117.)

RICE CULTIVATION AND TREATMENT.

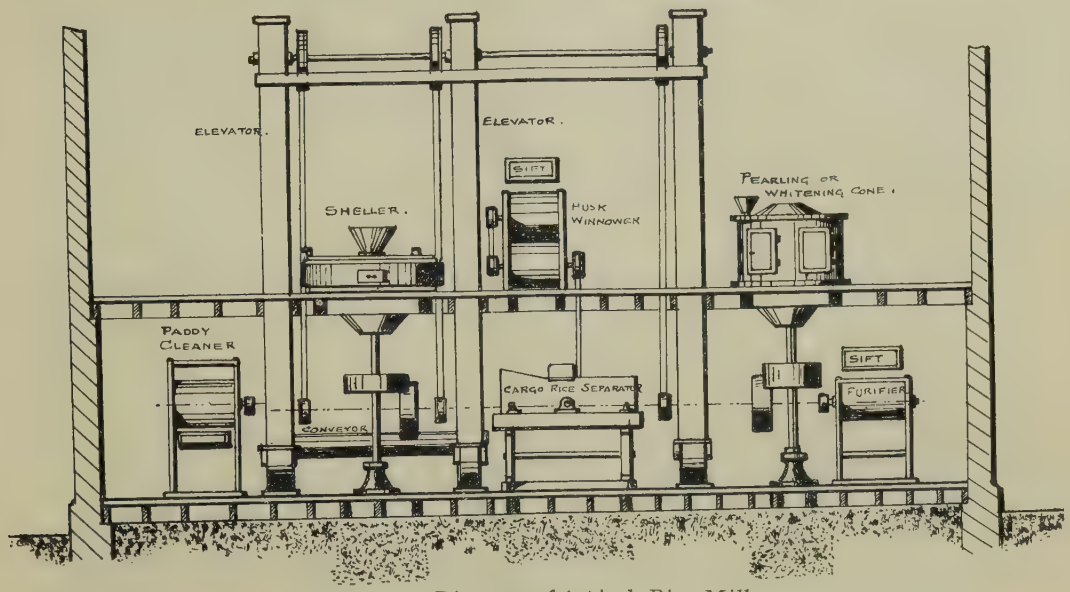

FIG. 5.—*Diagram of typical Rice Mill.*

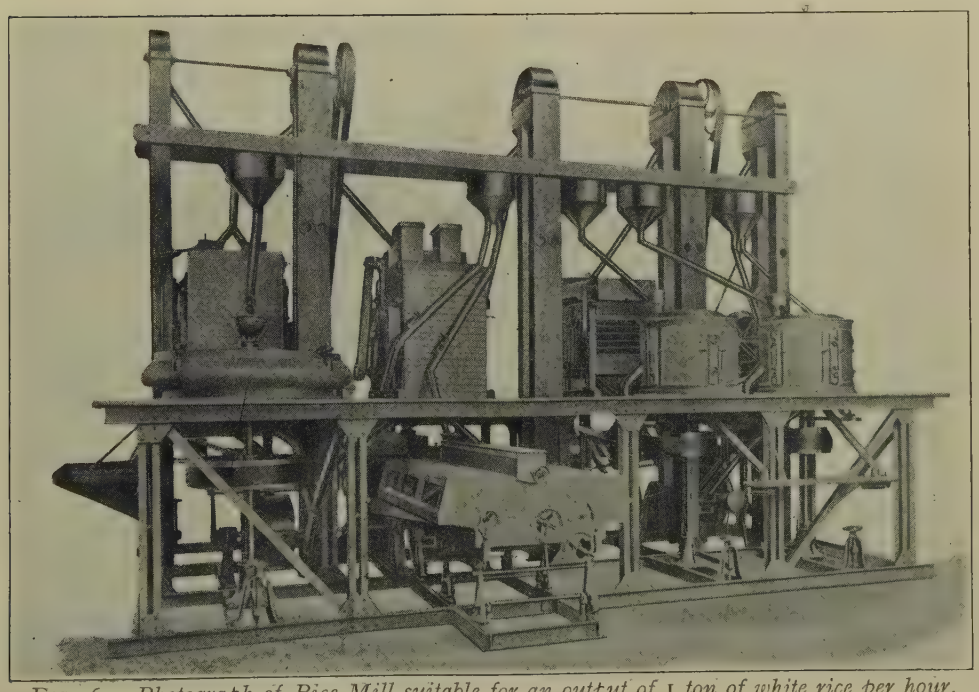

FIG. 6.—*Photograph of Rice Mill suitable for an output of 1 ton of white rice per hour.*

IMPERIAL COLLEGE ASSOCIATION FOOTBALL CLUB, 1929-30.

Photo by *H. O. Thomas*

Standing : V. A. Pope, L. C. W. Greaves, H. D. Leighton, I. C. Young, S. T. Hoyle, J. B. G. Savory, A. J. Kerr

Sitting : G. M. Roddan, H. H. Croucher, R. Johns (*Captain*), C. G. Akhurst, A. B. Stark.

IMPERIAL COLLEGE RUGBY FOOTBALL CLUB, 1929-30.

Photo by *H. O. Thomas*

Standing : Prof. H. R. Briton-Jones, E. O. Pearson, J. P. Maule, G. G. Gianetti, C. A. Thorold, N. R. Fuggles, J. G. Davies, I. C. Young.

Sitting : A. J. Kerr, L. P. McGuire, J. West, H. L. G. Milne (*Captain*), J. B. G. Savory, D. H. Brown, S. T. Hoyle.

On the ground : J. de la Bastide, J. R. Curry, F. B. Notley.

SPORTS.

Association Football Club, 1929-30.

THE club had a very successful season and succeeded in winning the Goodyear Trophy. The Club also entered for the Trinidad Association Cup, but was defeated in the first round. Four friendly games were played with local clubs. The season's results were as follows :—

MATCH RESULTS.

15th Oct.	*v.* Constabulary	H. Lost	0-3
31st do.	*v.* Casuals	A. Drawn	0-0
5th Nov.	*v.* Sporting Club	A. Lost	1-2
19th do.	*v.* Maple ; 1st round, Goodyear Trophy	A. Drawn	0-0
23rd do.	*v.* Sporting Club	H. Drawn	3-3
26th do.	*v.* Maple ; Replay Goodyear Trophy	A. Won	3-0
3rd Dec.	*v.* Myrtle ; 2nd round, Goodyear Trophy	A. Won	1-0
7th do.	*v.* Maple ; 1st round, T. F. A. Cup	A. Lost	0-1
13th do.	*v.* Everton ; Semi-final Goodyear Trophy	A. Won	2-0
19th do.	*v.* Casuals ; Final of Goodyear Trophy	A. Won	4-1

SUMMARY.

Games Played.	*Won.*	*Lost.*	*Drawn*	*Goals for*	*Goals against.*
10	4	3	3	14	10

The best game of the season was the final of the Goodyear Trophy played against the Casuals in Port-of-Spain. The Club was represented as follows :—

Goal :
G. Roddan.

Backs :
R. Johns, J. B. G. Savory.

Half-Backs :
H. D. Leighton, H. H. Croucher, V. A. Pope.

Forwards :
E. A. Chin, C. G. Akhurst, I. C. Young, A. B. Stark, A. J. Kerr.

In the first half of this game the College team was out-played but the Casuals succeeded in scoring only once. After this reverse the College forwards combined better and equalised the score just before half-time. In the second half the College eleven out-played the Casuals, the forwards excelling themselves by scoring three goals. The game was fast, clean, and played with a good sportsmanlike spirit ; in fact this was characteristic of all games played with local clubs, and there was a general feeling of regret that the Soccer season was so short. The Club is indebted to Mr. Hinds, Secretary of the Trinidad Football Association, for his kind consideration at all times and for the excellent manner with which he organised these games.

R. JOHNS, *Capt.*

Rugby Football Club.

THE College Rugby Football Club has had a very successful season in spite of many misfortunes. The first match, against Trinidad Northern R.F.C., resulted in a draw of "three-all" in spite of the fact that only a few days were available for the selection of a team. In the return match played in Port-of-Spain the following week the College won 4-0. A team, weakened by injuries, lost 3-9 to the All-Trinidad trial team which visited British Guiana. A series of pleasant matches with the Trinidad Southern R.F.C. was started on 10th November when the College won by 7-3.

Frequent changes had to be made in the team owing to the many injuries sustained. McGuire strained an arm muscle in the first match against the South and was compelled to retire for the rest of the season, while Lucie-Smith sustained a badly injured knee. McLuskie, an old Aberdeen Colour, whose magnificent play at "stand-off" was an example to all the team, broke his collar-bone in his second match for the College. The other injuries were of a temporary nature.

Savory, after having gained his laurels as back, excelled himself in the "three" line. Fuggles was converted from a forward into an excellent "scrum-half." The pack, which always consisted of Pearson (hooker), Maule, Thorold, Notley, Curry, West, Davies and Hoyle, was the best in the Island. Hoyle, whose play was exceptionally good, invariably attracted special attention. The combination in the forward line was very much better than that in the outfield. The "threes," although playing well individually, lacked combination. Gianetti, one of our fastest "threes," was often unavailable owing to an old injury to his knee. De la Bastide, another fast "three" did much to help the team, often going through three quarters of the field to score. Brown played consistently and very well indeed.

The thanks of the team are tendered to Dr. Briton-Jones for his keen interest and for refereeing in all home matches. We are grateful to the Northern and Southern teams for the very sporting games they gave us, and for their generous hospitality.

MATCH RESULTS.

Date.	*Opponents.*	*Ground.*	*Results.*
24th Oct.	Trinidad Northern	H.	Drawn 3-3
1st Nov.	Do. do.	A.	Won 4-0
3rd Nov.	All-Trinidad	H.	Lost 3-9
10th Nov.	Trinidad Southern	A.	Won 7-3
14th Nov.	Trinidad Northern	A.	Drawn 9-9
17th Nov.	Trinidad Southern	H.	Won 9-5
21st Nov.	Trinidad Northern	H.	Won 11-0
1st Dec.	Trinidad Southern	A.	Won 21-9
14th Dec.	Do. do.	H.	Won 13-0

SUMMARY.

Won.	*Lost.*	*Drawn.*	*Points for*	*Points against.*
6	1	2	80	38

H. L. G. MILNE, *Capt.*

REVIEWS.

Recent Changes in System of Husbandry in England.

(*Rothamsted Conference* No. 8.)

In the first of this collection of 12 papers, Sir John Russell traces an outline of the history of systematic farming in England since the adoption of the Norfolk four course rotation. He discusses in a general way the changes which have taken place during the last 60 years, due first to the importation of wheat, meats and dairy produce, then to the war and latterly to the considerably increased cost of labour. They are the causes of the necessary changes in farming practice, and the changes have included attempts, on the one hand, to reduce expenditure and on the other to increase the gross cash output of the farm. A summary is given of the various means by which the problem has been dealt with under each of these headings.

Mr. C. S. Orwin deals with the relative advantages of intensive and extensive farming as a solution of the problem which English farmers have to face to-day, and contrasts the results of "family farming" with those where the business is run on capitalist lines—the latter being the common system in England. In addition, mention is made of the possibilities of concentrating on the production of merely those products over which the English grower can command a virtual monopoly and of the "factory system" of producing certain commodities.

Most of the remaining ten papers are compiled by County Organisers and members of the staffs of farm institutes in various parts of the country who deal with the methods which farmers in their own particular districts have adopted in order to contend with the changes which have taken place in agricultural conditions.

Sugar beet growing has had a great influence on the re-arrangements of cropping in the root growing areas of East Anglia—a point to which attention is given by Colonel Long of Bury St. Edmunds. Mr. H. V. Taylor, of the Ministry of Agriculture, deals with the growing of fruit and vegetables as an adjunct to the farm.

D. B.

ACKNOWLEDGMENT.

Mr. H. C. Sampson has recently presented an assortment of indigenous West African hoes to the College, where they will be of great use to the Professor of Agriculture in his course on "Agriculture in the Tropics." Mr. Sampson in a covering letter, rightly calls attention to the necessity for close study of indigenous implements and the work they do, before any recommendations can be made for the importation of so called improved implements. The present collection includes some most interesting examples of native ingenuity.

COLLEGE NEWS.

Mr. A. G. Howell, Registrar, and Mrs. Howell, proceeded to England on leave by the s.s. *Bayano* on 6th June.

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During the absence of Mr. G. G. Gianetti, Professor C. Y. Shephard will act as Editor-Librarian in addition to his other duties.

* * *

Dr. H. R. Briton-Jones, with a party of eleven Colonial Office students, left by the s.s. *Lady* Hawkins on 4th June for a short visit to Barbados and St. Lucia, where opportunities will be afforded of studying the work and organisation of the local Agricultural Departments.

* * *

Dr. J. G. Myers left Trinidad by the s.s. *Venezuela* on 27th May to attend the third Imperial Entomological Conference to be held in London in June. After a period of leave he will return to Trinidad *via* the Far East, when it is expected that he will visit Ceylon, Java, Malaya, Fiji and Hawaii, during a tour that will extend over a period of six months or more.

* * *

Mr. and Mrs. G. A. Jones, Dr. and Mrs. C. W. Wardlaw, Mr. G. G. Gianetti and Assistant Professor F. W. Urich, left for England by the s.s. *Coronado* on 23rd May. Mr. Jones will attend the Botanical and Horticultural Conferences in London during August. Dr. Wardlaw will also attend the Botanical Conference and will be a member of the Conference, to be convened by the Empire Marketing Board in London during July, to consider Banana Research. Assistant Professor Urich will represent the College at the Entomological Conference which is to be held in London during June.

* * *

Miss E. O'Connor McCann who recently relinquished her post of Assistant Librarian, left for England by the s.s. *Coronado* on 23rd May. On Tuesday, 20th May, Miss McCann was presented with a cheque subscribed for her by members of the Staff, in token of the esteem in which she had been held by her colleagues during her period of four years service as Assistant Librarian. Mr. Gianetti took the opportunity of thanking her on behalf of the Staff for what she had done since her appointment and complimented her on the present efficient state of the Library, which he stated was mainly due to her great energy and keenness in carrying into effect the necessary organisation which had been devised for the rearrangement of the Library. The presentation was made by the Principal who voiced the feelings of all those present when he wished her all happiness and good fortune in her future career.

Amongst recent visitors to the College were Messrs. C. Farrar, C. C. Gibson and D. C. Bolin, who are prominently connected with the sugar planting industry in British Guiana. Mr. L. D. Cleare Jr., the Government Entomologist of that Colony, also paid several visits. Dr. A. D. R. O'Brien, C.M.G., M.C., who has been visiting the Lesser Antilles on behalf of the Colonial Office Medical Advisory Department, paid two visits and conferred with the Principal on matters of hygiene in which this Institution is interested. Sir Edward Denham, the new Governor of British Guiana, visited the College on 6th June. Other visitors included Mr. John R. Ernest, Vice-President of the National Association of Coffee Producers, Juan Vinas, Costa Rica; Capt. Ralph Leatham, R.N., and other officers of H.M.S. *Durban;* Capt. E. R. Corson, C.V.O., R.N., of H.M.S. *Heliotrope;* Mr. F. B. McCurdy, Halifax, Nova Scotia; Mr. C. J. H. Ferguson of San Leandro, California, and Mr. Robert P. Keith, Chemical Engineer of London.

FIELD EXPERIMENTS ON SUGAR-CANE.

THE article under this title, which appeared in the issues of *Tropical Agriculture* for April and May, 1930 (Vol. VII, Nos. 4 and 5, pp. 101 and 125), was written by Dr. E. J. Maskell (Cotton Research Station, Trinidad) and Mr. P. E. Turner (Lecturer in Chemistry). It is to be noted that this article is not an official publication of the special Sub-Committee appointed by the West Indies Conference of Agricultural Officers, nor does it necessarily present an unmodified description of the main recommendations of that Sub-Committee. The full Proceedings and Recommendations are now in the press and will be available in the near future.—EDITOR.

BIOLOGICAL EXCURSIONS.

An Excursion to the Aripo Cavern.

A BIOLOGICAL EXCURSION was made to the Aripo Cavern on Saturday, 17th May, attended by Messrs. Wardlaw, Briant and Pickles, and a party of nine post-graduate and diploma students.

After some delay, due to the non-arrival of our guide, a start was at last made from Melton Estate in the Aripo Valley. The early part of the route lay through cocoa cultivations, with here and there a well-established *Castilca* tree, reminiscent of the early days of the rubber industry. As we proceeded, the track became more and more obscure and ascended more steeply until we found ourselves on the edge of primeval forest which has been practically untouched from time immemorial, save for the occasional opening of the blazed trail which we were to follow.

Surely, never was a day so hot! The way is rough at the best of times and on this occasion, the recent rain which had made the track very slippery, together with the excessive heat, rendered our progress very trying indeed. However, an hour's toil brought us to "Broadway Camp" with its single orange tree, where the late Government Botanist once camped for several weeks, far away from all voices save those of toucans and bell-birds. A descent to the river which followed down the face of a cliff, was soon accomplished thanks to the friendly lianes in our path. By common consent, a five minutes halt was called at the river, water bottles were filled and we were prepared to tackle the remainder of the journey with renewed vigour. A stiff climb followed, after which we turned aside from the trail which leads to the summit of the mountain, to follow one along the course of a tiny stream. After a short space, a welcome shout from the leading files announced our arrival at the cave.

The cavern itself proved to be a semi-circular opening in the side of a hill, some 20 feet in height. Its rock-strewn floor descended rapidly into the darkness and small stalactites depended from the roof. Visibility in the semi-darkness was poor on account of mist wraiths, but the incessant hoarse screams of protest left no doubt that here was the home of the guacharo birds, the object of our journey.

These extraordinary birds were first mentioned by Humboldt in his *Travels to the Equinoctial Regions of America*, in which he records finding them on the mainland near the Convent of Caripe. He describes them as dark bluish-grey in colour, mixed with streaks of black and with large white spots in the form of a heart on the head, wings and tail. They are nocturnal in habit, leaving the cave at night to feed on palm fruits which form their chief, if not their sole source of food. The palm seeds are not digested and pass through the alimentary tract unharmed. In consequence, the guano which is always abundant around guacharo nesting sites, supports a veritable forest of etiolated palm seedlings.

The nests are pillar-like erections of wood fibre, built on shelves of rock, with a depression in the top in which the eggs are laid and the young are reared. The nestlings are much esteemed for the fat which they contain in enormous quantities. Humboldt, extolling the purity of guacharo fat, states that it may be kept for over a year without becoming rancid. So great was the demand for this product at one time, and so ruthless were the methods adopted to supply it, that legislative protection became necessary in Trinidad and is still enforced.

Some members of our party descended further into the cave which is reputed to extend for some two miles, but the difficulties of progress soon became insuperable and shortly after lunch, the uneventful return journey was commenced.

The thanks of all members of the party are due to Mr. L. S. Dade for permitting us to pass through Melton Estate and for most kindly making preliminary arrangements for opening up the track, without which the expedition would have been impossible.

A. P.

TREND OF THE MARKETS.

[*The notes below are based principally upon running charts of the prices of the basic grades and upon general statistical information gleaned from contemporary publications and cablegrams and are intended to be a record of movements. An attempt is made, where possible, to indicate the market outlook at the time of going to press, but no responsibility for the accuracy and subsequent truth of such observations is assumed. Unless otherwise stated the prices quoted are spot, London.*]

SUGAR.—Prices on the Home Market have ranged as follows (c.i.f. per cwt.):—

	Foreign.		*Preferential.*	
	s.	*d.*	*s.*	*d.*
24th April ..	7	6¾	11	3¾
1st May ..	7	5½	11	3
7th May ..	7	1½	11	0
14th May ..	6	9	10	7½
21st May ..	7	1½	11	0
28th May ..	6	9	10	9
4th June ..	6	10½	10	6

Sugar prices have continued to decline and have reached such low levels that it is difficult to recall a more depressing condition. The market is completely without confidence and buyers continue their attitude of indifference. The situation in the British Crown Colonies is critical and measures are now being introduced by several Governments to subsidise the sugar industry in order to prevent its collapse and the concomitant distress among the labouring population. In spite of the reduction of invisible stocks in the important consuming countries, the tone of the market has failed to improve and there is no factor tending to relieve the prevailing gloom.

* * *

COTTON.—The following are the official spot prices in pence per lb. of the Liverpool Cotton Association:—

	American Mid.	*Egyptian F. G. F. Sakel.*	*Sea Island.*		
			Good.	*Extra fine.*	*Prices paid this Week.*
25th Apr.	8·74	14·30	24·50	38·00	26·00
2nd May	8·65	14·25	24·50	38·00	23·00-29·00
9th May	8·63	—	24·50	38·00	20·00-28·50
16th May	8·54	—	24·50	38·00	24·00 26·50
4th June .... (local)	8·43	—	24·50	38·00	—

After a slight improvement in Middling American during the fourth week in April cotton was in moderate request, quotations showing a decline. Sea Island was in rather better demand at steady prices.

COCOA.—Statistically the position has improved yet prices continue to weaken. Visible stocks in five ports (New York, Havre, Lisbon, London and Liverpool) on 30th April were approximately 175,000 bags less than a year ago. Furthermore total production for 1929 amounted to 534,400 tons against consumption for the same year of 538,600 tons. This would appear to point to higher prices.—(*By courtesy of the Cocoa Planters' Association, Trinidad.*)

* * *

COFFEE.—Average prices for Costa Rican Middling and Kenya Good Middling have weakened being 135*s.* and 115*s.* per cwt. respectively during the fortnight ended 14th May. Jamaica has remained steady at 190*s.* while Santos hardened to 65*s.*—(*Times, Trades and Engineering Supplement,* 17th May.)

* * *

TEA.—Ceylon and Indian averages show a decline in our last quotations. Prices for the week ended 14th May averaged 20.16*d.* for Ceylon, 16.02*d.* for Indian, and 11.10*d.* for Java, each per lb. The quantity sold exceeds that of last year.—(*Times, Trade and Engineering Supplement,* 17th May.)

* * *

RUBBER.—Quotations for Plantation Sheet have ranged as follows:—24th April, $7\frac{3}{16}$*d.*; 1st May, 7*d.*; 7th May, $6\frac{15}{16}$*d.*; 14th May, $7\frac{1}{16}$*d.*; 21st May, $6\frac{3}{4}$*d.*; 28th May, $6\frac{1}{8}$*d.*; 4th June, $6\frac{5}{8}$*d.* The condition of the market has remained lethargic and movements have been small. The May tapping holiday is now being observed in the East and will probably reduce shipments but it is unlikely that the effect will be noticeable until June or July.

* * *

BANANAS.—Jamaicas are in fair to good demand, but the unfavourable weather has tended to check consumption. Prices are unchanged at: wholesale, £24 per ton delivered, or £23 10*s.* delivered nearest railway station; retail, 10*d.* to 1*s.* per dozen, carriage extra. Brazilians are in good demand and £2 higher on the fortnight at £22 per ton delivered nearest railway station.—(*West India Committee Circular,* 15th May.)

* * *

LIME PRODUCTS.—*Lime Oil.*—Handpressed is nominally worth 50*s.* per lb. but no business is reported. Distilled is neglected and price is a matter for negotiation. *Lime Juice.*—There is no demand for Concentrated and Raw is slow of sale without quotable change.—(*West India Committee Circular,* 15th May.)

THE EDITOR requests that any subscriber who fails to receive *Tropical Agriculture* regularly should communicate with him immediately in order that the matter may be rectified.